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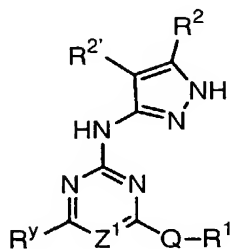
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(54) Title: PYRAZOLE COMPOUNDS USEFUL AS PROTEIN KINASE INHIBITORS



(57) Abstract: This invention describes novel pyrazole compounds of formula II: wherein Z<sup>1</sup> is nitrogen or CR<sup>8</sup>; Q is -S-, -O-, -N(R<sup>4</sup>)-, or -CH (R<sup>6</sup>)-; R<sup>1</sup> is T-Ring D, wherein Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl; and R<sup>3</sup>, R<sup>2</sup>, and R<sup>2'</sup> are as described in the specification. The compounds are useful as protein kinase inhibitors, especially as inhibitors of Aurora-2 and GSK-3, for treating diseases such as cancer, diabetes and Alzheimer's disease.

PYRAZOLE COMPOUNDS USEFUL AS PROTEIN KINASE INHIBITORSCROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to US Provisional Patent Application 60/257,887 filed December 21, 2000 and US Provisional Patent Application 60/286,949 filed April 27, 2001, the contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention is in the field of medicinal chemistry and relates to compounds that are protein kinase inhibitors, compositions containing such compounds and methods of use. More particularly, this  
5 invention relates to compounds that are inhibitors of Aurora-2 protein kinase. The invention also relates to methods of treating diseases associated with protein kinases, especially diseases associated with Aurora-2, such as cancer.

10

BACKGROUND OF THE INVENTION

The search for new therapeutic agents has been greatly aided in recent years by better understanding of the structure of enzymes and other biomolecules  
15 associated with target diseases. One important class of enzymes that has been the subject of extensive study is the protein kinases.

Protein kinases mediate intracellular signal transduction. They do this by effecting a phosphoryl  
20 transfer from a nucleoside triphosphate to a protein acceptor that is involved in a signaling pathway. There are a number of kinases and pathways through which

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extracellular and other stimuli cause a variety of cellular responses to occur inside the cell. Examples of such stimuli include environmental and chemical stress signals (e.g. osmotic shock, heat shock, ultraviolet radiation, bacterial endotoxin, H<sub>2</sub>O<sub>2</sub>), cytokines (e.g. interleukin-1 (IL-1) and tumor necrosis factor  $\alpha$  (TNF- $\alpha$ )), and growth factors (e.g. granulocyte macrophage-colony-stimulating factor (GM-CSF), and fibroblast growth factor (FGF)). An extracellular stimulus may effect one or more cellular responses related to cell growth, migration, differentiation, secretion of hormones, activation of transcription factors, muscle contraction, glucose metabolism, control of protein synthesis and regulation of cell cycle.

Many diseases are associated with abnormal cellular responses triggered by protein kinase-mediated events. These diseases include autoimmune diseases, inflammatory diseases, neurological and neurodegenerative diseases, cancer, cardiovascular diseases, allergies and asthma, Alzheimer's disease or hormone-related diseases. Accordingly, there has been a substantial effort in medicinal chemistry to find protein kinase inhibitors that are effective as therapeutic agents.

Aurora-2 is a serine/threonine protein kinase that has been implicated in human cancer, such as colon, breast and other solid tumors. This kinase is believed to be involved in protein phosphorylation events that regulate the cell cycle. Specifically, Aurora-2 may play a role in controlling the accurate segregation of chromosomes during mitosis. Misregulation of the cell cycle can lead to cellular proliferation and other abnormalities. In human colon cancer tissue, the aurora-2 protein has been found to be overexpressed. See

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Bischoff et al., *EMBO J.*, 1998, 17, 3052-3065; Schumacher et al., *J. Cell Biol.*, 1998, 143, 1635-1646; Kimura et al., *J. Biol. Chem.*, 1997, 272, 13766-13771.

Glycogen synthase kinase-3 (GSK-3) is a  
5 serine/threonine protein kinase comprised of  $\alpha$  and  $\beta$   
isoforms that are each encoded by distinct genes [Coghlan  
et al., *Chemistry & Biology*, 7, 793-803 (2000); Kim and  
Kimmel, *Curr. Opinion Genetics Dev.*, 10, 508-514 (2000)].  
GSK-3 has been implicated in various diseases including  
10 diabetes, Alzheimer's disease, CNS disorders such as  
manic depressive disorder and neurodegenerative diseases,  
and cardiomyocyte hypertrophy [WO 99/65897; WO 00/38675;  
and Haq et al., *J. Cell Biol.* (2000) 151, 117]. These  
diseases may be caused by, or result in, the abnormal  
15 operation of certain cell signaling pathways in which  
GSK-3 plays a role. GSK-3 has been found to  
phosphorylate and modulate the activity of a number of  
regulatory proteins. These proteins include glycogen  
synthase which is the rate limiting enzyme necessary for  
20 glycogen synthesis, the microtubule associated protein  
Tau, the gene transcription factor  $\beta$ -catenin, the  
translation initiation factor eIF2B, as well as ATP  
citrate lyase, axin, heat shock factor-1, c-Jun, c-Myc,  
c-Myb, CREB, and CEPB $\alpha$ . These diverse protein targets  
25 implicate GSK-3 in many aspects of cellular metabolism,  
proliferation, differentiation and development.

In a GSK-3 mediated pathway that is relevant  
for the treatment of type II diabetes, insulin-induced  
signaling leads to cellular glucose uptake and glycogen  
30 synthesis. Along this pathway, GSK-3 is a negative  
regulator of the insulin-induced signal. Normally, the  
presence of insulin causes inhibition of GSK-3 mediated



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phosphorylation and deactivation of glycogen synthase. The inhibition of GSK-3 leads to increased glycogen synthesis and glucose uptake [Klein et al., *PNAS*, 93, 8455-9 (1996); Cross et al., *Biochem. J.*, 303, 21-26 (1994); Cohen, *Biochem. Soc. Trans.*, 21, 555-567 (1993); Massillon et al., *Biochem J.* 299, 123-128 (1994)]. However, in a diabetic patient where the insulin response is impaired, glycogen synthesis and glucose uptake fail to increase despite the presence of relatively high blood levels of insulin. This leads to abnormally high blood levels of glucose with acute and long term effects that may ultimately result in cardiovascular disease, renal failure and blindness. In such patients, the normal insulin-induced inhibition of GSK-3 fails to occur. It has also been reported that in patients with type II diabetes, GSK-3 is overexpressed [WO 00/38675]. Therapeutic inhibitors of GSK-3 are therefore potentially useful for treating diabetic patients suffering from an impaired response to insulin.

GSK-3 activity has also been associated with Alzheimer's disease. This disease is characterized by the well-known  $\beta$ -amyloid peptide and the formation of intracellular neurofibrillary tangles. The neurofibrillary tangles contain hyperphosphorylated Tau protein where Tau is phosphorylated on abnormal sites. GSK-3 has been shown to phosphorylate these abnormal sites in cell and animal models. Furthermore, inhibition of GSK-3 has been shown to prevent hyperphosphorylation of Tau in cells [Lovestone et al., *Current Biology* 4, 1077-86 (1994); Brownlees et al., *Neuroreport* 8, 3251-55 (1997)]. Therefore, it is believed that GSK-3 activity may promote generation of the neurofibrillary tangles and the progression of Alzheimer's disease.

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Another substrate of GSK-3 is  $\beta$ -catenin which is degraded after phosphorylation by GSK-3. Reduced levels of  $\beta$ -catenin have been reported in schizophrenic patients and have also been associated with other  
5 diseases related to increase in neuronal cell death [Zhong et al., *Nature*, 395, 698-702 (1998); Takashima et al., *PNAS*, 90, 7789-93 (1993); Pei et al., *J. Neuropathol. Exp*, 56, 70-78 (1997)].

As a result of the biological importance of  
10 GSK-3, there is current interest in therapeutically effective GSK-3 inhibitors. Small molecules that inhibit GSK-3 have recently been reported [WO 99/65897 (Chiron) and WO 00/38675 (SmithKline Beecham)].

For many of the aforementioned diseases  
15 associated with abnormal GSK-3 activity, other protein kinases have also been targeted for treating the same diseases. However, the various protein kinases often act through different biological pathways. For example, certain quinazoline derivatives have been reported  
20 recently as inhibitors of p38 kinase (WO 00/12497 to Scios). The compounds are reported to be useful for treating conditions characterized by enhanced p38- $\alpha$  activity and/or enhanced TGF- $\beta$  activity. While p38 activity has been implicated in a wide variety of  
25 diseases, including diabetes, p38 kinase is not reported to be a constituent of an insulin signaling pathway that regulates glycogen synthesis or glucose uptake. Therefore, unlike GSK-3, p38 inhibition would not be  
30 uptake.

There is a continued need to find new therapeutic agents to treat human diseases. The protein

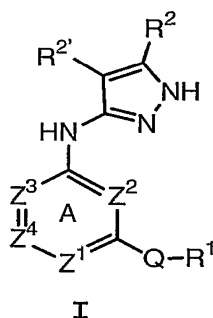
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kinases Aurora-2 and GSK-3 are especially attractive targets for the discovery of new therapeutics due to their important roles in cancer and diabetes, respectively.

5

# DESCRIPTION OF THE INVENTION

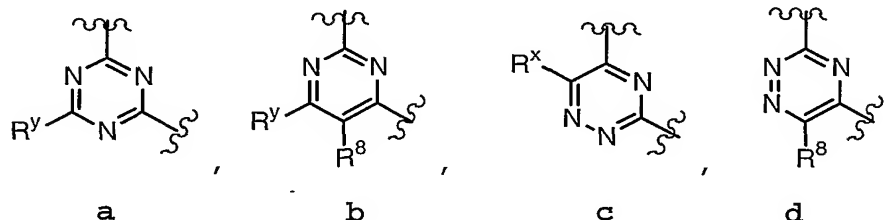
It has now been found that compounds of this invention and pharmaceutical compositions thereof are effective as protein kinase inhibitors, particularly as inhibitors of Aurora-2. These compounds have the general formula I:



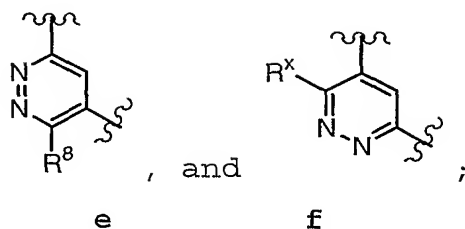
or a pharmaceutically acceptable derivative or prodrug thereof, wherein:

Z¹ to Z⁴ are as described below;

15 Ring A is selected from the group consisting of:



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$R^x$  is  $T-R^3$  or  $L-Z-R^3$ ;

$R^y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms, or  $R^y$  and  $R^8$  are taken together to form a fused, optionally substituted 5-7 membered, unsaturated or partially unsaturated, ring having 0-3 ring heteroatoms selected from nitrogen, oxygen, or sulfur;

$Q$  is selected from  $-N(R^4)-$ ,  $-O-$ ,  $-S-$ , or  $-CH(R^6)-$ ;

10  $R^1$  is  $T-(\text{Ring D})$ ;

Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl, said heteroaryl or heterocyclyl ring having 1-4 ring heteroatoms selected from nitrogen, oxygen or sulfur, wherein each substitutable ring carbon of Ring D is independently substituted by oxo,  $T-R^5$ , or  $V-Z-R^5$ , and each substitutable ring nitrogen of Ring D is independently substituted by  $-R^4$ ;

20  $T$  is a valence bond or a  $C_{1-4}$  alkylidene chain, wherein when  $Q$  is  $-CH(R^6)-$ , a methylene unit of said  $C_{1-4}$  alkylidene chain is optionally replaced by  $-O-$ ,  $-S-$ ,  $-N(R^4)-$ ,  $-CO-$ ,  $-CONH-$ ,  $-NHCO-$ ,  $-SO_2-$ ,  $-SO_2NH-$ ,  $-NHSO_2-$ ,  $-CO_2-$ ,  $-OC(O)-$ ,  $-OC(O)NH-$ , or  $-NHCO_2-$ ;

25  $Z$  is a  $C_{1-4}$  alkylidene chain;

$L$  is  $-O-$ ,  $-S-$ ,  $-SO-$ ,  $-SO_2-$ ,  $-N(R^6)SO_2-$ ,  $-SO_2N(R^6)-$ ,  $-N(R^6)-$ ,  $-CO-$ ,  $-CO_2-$ ,  $-N(R^6)CO-$ ,  $-N(R^6)C(O)O-$ ,

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$-N(R^6)CON(R^6)-$ ,  $-N(R^6)SO_2N(R^6)-$ ,  $-N(R^6)N(R^6)-$ ,  
 $-C(O)N(R^6)-$ ,  $-OC(O)N(R^6)-$ ,  $-C(R^6)_2O-$ ,  $-C(R^6)_2S-$ ,  
 $-C(R^6)_2SO-$ ,  $-C(R^6)_2SO_2-$ ,  $-C(R^6)_2SO_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)-$ ,  
 $-C(R^6)_2N(R^6)C(O)-$ ,  $-C(R^6)_2N(R^6)C(O)O-$ ,  $-C(R^6)=NN(R^6)-$ ,  
5  $-C(R^6)=N-O-$ ,  $-C(R^6)_2N(R^6)N(R^6)-$ ,  $-C(R^6)_2N(R^6)SO_2N(R^6)-$ , or  
 $-C(R^6)_2N(R^6)CON(R^6)-$ ;

$R^2$  and  $R^{2'}$  are independently selected from  $-R$ ,  $-T-W-R^6$ , or  
 $R^2$  and  $R^{2'}$  are taken together with their intervening  
atoms to form a fused, 5-8 membered, unsaturated or  
10 partially unsaturated, ring having 0-3 ring heteroatoms  
selected from nitrogen, oxygen, or sulfur, wherein each  
substitutable ring carbon of said fused ring formed by  
 $R^2$  and  $R^{2'}$  is independently substituted by halo, oxo,  
 $-CN$ ,  $-NO_2$ ,  $-R^7$ , or  $-V-R^6$ , and each substitutable ring  
15 nitrogen of said ring formed by  $R^2$  and  $R^{2'}$  is  
independently substituted by  $R^4$ ;

$R^3$  is selected from  $-R$ ,  $-halo$ ,  $-OR$ ,  $-C(=O)R$ ,  $-CO_2R$ ,  
 $-COCOR$ ,  $-COCH_2COR$ ,  $-NO_2$ ,  $-CN$ ,  $-S(O)R$ ,  $-S(O)_2R$ ,  $-SR$ ,  
 $-N(R^4)_2$ ,  $-CON(R^7)_2$ ,  $-SO_2N(R^7)_2$ ,  $-OC(=O)R$ ,  $-N(R^7)COR$ ,  
20  $-N(R^7)CO_2(C_{1-6} \text{ aliphatic})$ ,  $-N(R^4)N(R^4)_2$ ,  $-C=NN(R^4)_2$ ,  
 $-C=N-OR$ ,  $-N(R^7)CON(R^7)_2$ ,  $-N(R^7)SO_2N(R^7)_2$ ,  $-N(R^4)SO_2R$ , or  
 $-OC(=O)N(R^7)_2$ ;

$R^{3'}$  is selected from  $-halo$ ,  $-OR$ ,  $-C(=O)R$ ,  $-CO_2R$ ,  $-COCOR$ ,  
 $-COCH_2COR$ ,  $-NO_2$ ,  $-CN$ ,  $-S(O)R$ ,  $-S(O)_2R$ ,  $-SR$ ,  $-N(R^4)_2$ ,  
25  $-CON(R^7)_2$ ,  $-SO_2N(R^7)_2$ ,  $-OC(=O)R$ ,  $-N(R^7)COR$ ,  $-N(R^7)CO_2(C_{1-6}$   
 $\text{aliphatic})$ ,  $-N(R^4)N(R^4)_2$ ,  $-C=NN(R^4)_2$ ,  $-C=N-OR$ ,  
 $-N(R^7)CON(R^7)_2$ ,  $-N(R^7)SO_2N(R^7)_2$ ,  $-N(R^4)SO_2R$ ,  
 $-OC(=O)N(R^7)_2$ , or an optionally substituted group  
selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl  
30 ring having 5-10 ring atoms, or a heterocyclyl ring  
having 5-10 ring atoms;

each  $R$  is independently selected from hydrogen or an  
optionally substituted group selected from  $C_{1-6}$

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aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;

each R<sup>4</sup> is independently selected from -R<sup>7</sup>, -COR<sup>7</sup>,

5 -CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic), -CON(R<sup>7</sup>)<sub>2</sub>,  
or -SO<sub>2</sub>R<sup>7</sup>;

each R<sup>5</sup> is independently selected from -R, halo, -OR,

-C(=O)R, -CO<sub>2</sub>R, -COCOR, -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR,

-N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR,

10 -N(R<sup>4</sup>)CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic),

-N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>,

-N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or -OC(=O)N(R<sup>4</sup>)<sub>2</sub>;

V is -O-, -S-, -SO-, -SO<sub>2</sub>-, -N(R<sup>6</sup>)SO<sub>2</sub>-, -SO<sub>2</sub>N(R<sup>6</sup>)-,

-N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -N(R<sup>6</sup>)CO-, -N(R<sup>6</sup>)C(O)O-,

15 -N(R<sup>6</sup>)CON(R<sup>6</sup>)-, -N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)N(R<sup>6</sup>)-,

-C(O)N(R<sup>6</sup>)-, -OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-,

-C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-,

-C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-,

-C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, or

20 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-;

W is -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-,

-C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-,

-C(R<sup>6</sup>)OC(O)-, -C(R<sup>6</sup>)OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CO-,

-C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-,

25 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-,

-C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-, or -CON(R<sup>6</sup>)-;

each R<sup>6</sup> is independently selected from hydrogen or an

optionally substituted C<sub>1-4</sub> aliphatic group, or two R<sup>6</sup>

groups on the same nitrogen atom are taken together

30 with the nitrogen atom to form a 5-6 membered

heterocyclyl or heteroaryl ring;

each R<sup>7</sup> is independently selected from hydrogen or an

optionally substituted C<sub>1-6</sub> aliphatic group, or two R<sup>7</sup>

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on the same nitrogen are taken together with the nitrogen to form a 5-8 membered heterocyclyl or heteroaryl ring; and

$R^8$  is selected from -R, halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR, -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or -OC(=O)N(R<sup>4</sup>)<sub>2</sub>.

As used herein, the following definitions shall apply unless otherwise indicated. The phrase "optionally substituted" is used interchangeably with the phrase "substituted or unsubstituted" or with the term "(un)substituted." Unless otherwise indicated, an optionally substituted group may have a substituent at each substitutable position of the group, and each substitution is independent of the other.

The term "aliphatic" as used herein means straight-chain, branched or cyclic C<sub>1</sub>-C<sub>12</sub> hydrocarbons which are completely saturated or which contain one or more units of unsaturation but which are not aromatic. For example, suitable aliphatic groups include substituted or unsubstituted linear, branched or cyclic alkyl, alkenyl, alkynyl groups and hybrids thereof such as (cycloalkyl)alkyl, (cycloalkenyl)alkyl or (cycloalkyl)alkenyl. The terms "alkyl", "alkoxy", "hydroxyalkyl", "alkoxyalkyl", and "alkoxycarbonyl", used alone or as part of a larger moiety includes both straight and branched chains containing one to twelve carbon atoms. The terms "alkenyl" and "alkynyl" used alone or as part of a larger moiety shall include both straight and branched chains containing two to twelve carbon atoms. The term "cycloalkyl" used alone or as

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part of a larger moiety shall include cyclic C<sub>3</sub>-C<sub>12</sub> hydrocarbons which are completely saturated or which contain one or more units of unsaturation, but which are not aromatic.

5           The terms "haloalkyl", "haloalkenyl" and "haloalkoxy" means alkyl, alkenyl or alkoxy, as the case may be, substituted with one or more halogen atoms. The term "halogen" means F, Cl, Br, or I.

          The term "heteroatom" means nitrogen, oxygen,  
10 or sulfur and includes any oxidized form of nitrogen and sulfur, and the quaternized form of any basic nitrogen. Also the term "nitrogen" includes a substitutable nitrogen of a heterocyclic ring. As an example, in a saturated or partially unsaturated ring having 0-3  
15 heteroatoms selected from oxygen, sulfur or nitrogen, the nitrogen may be N (as in 3,4-dihydro-2*H*-pyrrolyl), NH (as in pyrrolidinyl) or NR<sup>+</sup> (as in N-substituted pyrrolidinyl).

          The terms "carbocycle", "carbocyclyl",  
20 "carbocyclo", or "carbocyclic" as used herein means an aliphatic ring system having three to fourteen members. The terms "carbocycle", "carbocyclyl", "carbocyclo", or "carbocyclic" whether saturated or partially unsaturated, also refers to rings that are optionally substituted.  
25 The terms "carbocycle", "carbocyclyl", "carbocyclo", or "carbocyclic" also include aliphatic rings that are fused to one or more aromatic or nonaromatic rings, such as in a decahydronaphthyl or tetrahydronaphthyl, where the radical or point of attachment is on the aliphatic ring.

30           The term "aryl" used alone or as part of a larger moiety as in "aralkyl", "aralkoxy", or "aryloxyalkyl", refers to aromatic ring groups having five to fourteen members, such as phenyl, benzyl,



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phenethyl, 1-naphthyl, 2-naphthyl, 1-anthracyl and 2-anthracyl. The term "aryl" also refers to rings that are optionally substituted. The term "aryl" may be used interchangeably with the term "aryl ring". "Aryl" also  
5 includes fused polycyclic aromatic ring systems in which an aromatic ring is fused to one or more rings. Examples include 1-naphthyl, 2-naphthyl, 1-anthracyl and 2-anthracyl. Also included within the scope of the term "aryl", as it is used herein, is a group in which an  
10 aromatic ring is fused to one or more non-aromatic rings, such as in an indanyl, phenanthridinyl, or tetrahydronaphthyl, where the radical or point of attachment is on the aromatic ring.

The term "heterocycle", "heterocyclyl", or  
15 "heterocyclic" as used herein includes non-aromatic ring systems having five to fourteen members, preferably five to ten, in which one or more ring carbons, preferably one to four, are each replaced by a heteroatom such as N, O, or S. Examples of heterocyclic rings include 3-1H-  
20 benzimidazol-2-one, (1-substituted)-2-oxo-benzimidazol-3-yl, 2-tetrahydrofuranyl, 3-tetrahydrofuranyl, 2-tetrahydropyranyl, 3-tetrahydropyranyl, 4-tetrahydropyranyl, [1,3]-dioxalanyl, [1,3]-dithiolanyl, [1,3]-dioxanyl, 2-tetrahydrothiophenyl, 3-  
25 tetrahydrothiophenyl, 2-morpholinyl, 3-morpholinyl, 4-morpholinyl, 2-thiomorpholinyl, 3-thiomorpholinyl, 4-thiomorpholinyl, 1-pyrrolidinyl, 2-pyrrolidinyl, 3-pyrrolidinyl, 1-piperazinyl, 2-piperazinyl, 1-piperidinyl, 2-piperidinyl, 3-piperidinyl, 4-piperidinyl,  
30 4-thiazolidinyl, diazolonyl, N-substituted diazolonyl, 1-phthalimidinyl, benzoxanyl, benzopyrrolidinyl, benzopiperidinyl, benzoxolanyl, benzothiolanyl, and benzothianyl. Also included within the scope of the term

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"heterocyclyl" or "heterocyclic", as it is used herein, is a group in which a non-aromatic heteroatom-containing ring is fused to one or more aromatic or non-aromatic rings, such as in an indolinyl, chromanyl, phenanthridinyl, or tetrahydroquinolinyl, where the radical or point of attachment is on the non-aromatic heteroatom-containing ring. The term "heterocycle", "heterocyclyl", or "heterocyclic" whether saturated or partially unsaturated, also refers to rings that are optionally substituted.

The term "heteroaryl", used alone or as part of a larger moiety as in "heteroaralkyl" or "heteroarylalkoxy", refers to heteroaromatic ring groups having five to fourteen members. Examples of heteroaryl rings include 2-furanyl, 3-furanyl, N-imidazolyl, 2-imidazolyl, 4-imidazolyl, 5-imidazolyl, 3-isoxazolyl, 4-isoxazolyl, 5-isoxazolyl, 2-oxadiazolyl, 5-oxadiazolyl, 2-oxazolyl, 4-oxazolyl, 5-oxazolyl, 1-pyrrolyl, 2-pyrrolyl, 3-pyrrolyl, 2-pyridyl, 3-pyridyl, 4-pyridyl, 2-pyrimidyl, 4-pyrimidyl, 5-pyrimidyl, 3-pyridazinyl, 2-thiazolyl, 4-thiazolyl, 5-thiazolyl, 5-tetrazolyl, 2-triazolyl, 5-triazolyl, 2-thienyl, 3-thienyl, carbazolyl, benzimidazolyl, benzothienyl, benzofuranyl, indolyl, quinolinyl, benzotriazolyl, benzothiazolyl, benzooxazolyl, benzimidazolyl, isoquinolinyl, indazolyl, isoindolyl, acridinyl, or benzoisoxazolyl. Also included within the scope of the term "heteroaryl", as it is used herein, is a group in which a heteroatomic ring is fused to one or more aromatic or nonaromatic rings where the radical or point of attachment is on the heteroaromatic ring. Examples include tetrahydroquinolinyl, tetrahydroisoquinolinyl, and pyrido[3,4-d]pyrimidinyl. The term "heteroaryl" also refers to rings that are

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optionally substituted. The term "heteroaryl" may be used interchangeably with the term "heteroaryl ring" or the term "heteroaromatic".

An aryl (including aralkyl, aralkoxy, aryloxyalkyl and the like) or heteroaryl (including heteroaralkyl and heteroarylalkoxy and the like) group may contain one or more substituents. Examples of suitable substituents on the unsaturated carbon atom of an aryl, heteroaryl, aralkyl, or heteroaralkyl group include a halogen,  $-R^\circ$ ,  $-OR^\circ$ ,  $-SR^\circ$ , 1,2-methylene-dioxy, 1,2-ethylenedioxy, protected OH (such as acyloxy), phenyl (Ph), substituted Ph,  $-O(Ph)$ , substituted  $-O(Ph)$ ,  $-CH_2(Ph)$ , substituted  $-CH_2(Ph)$ ,  $-CH_2CH_2(Ph)$ , substituted  $-CH_2CH_2(Ph)$ ,  $-NO_2$ ,  $-CN$ ,  $-N(R^\circ)_2$ ,  $-NR^\circ C(O)R^\circ$ ,  $-NR^\circ C(O)N(R^\circ)_2$ ,  $-NR^\circ CO_2R^\circ$ ,  $-NR^\circ NR^\circ C(O)R^\circ$ ,  $-NR^\circ NR^\circ C(O)N(R^\circ)_2$ ,  $-NR^\circ NR^\circ CO_2R^\circ$ ,  $-C(O)C(O)R^\circ$ ,  $-C(O)CH_2C(O)R^\circ$ ,  $-CO_2R^\circ$ ,  $-C(O)R^\circ$ ,  $-C(O)N(R^\circ)_2$ ,  $-OC(O)N(R^\circ)_2$ ,  $-S(O)_2R^\circ$ ,  $-SO_2N(R^\circ)_2$ ,  $-S(O)R^\circ$ ,  $-NR^\circ SO_2N(R^\circ)_2$ ,  $-NR^\circ SO_2R^\circ$ ,  $-C(=S)N(R^\circ)_2$ ,  $-C(=NH)-N(R^\circ)_2$ ,  $-(CH_2)_yNHC(O)R^\circ$ ,  $-(CH_2)_yNHC(O)CH(V-R^\circ)(R^\circ)$ ; wherein  $R^\circ$  is hydrogen, a substituted or unsubstituted aliphatic group, an unsubstituted heteroaryl or heterocyclic ring, phenyl (Ph), substituted Ph,  $-O(Ph)$ , substituted  $-O(Ph)$ ,  $-CH_2(Ph)$ , or substituted  $-CH_2(Ph)$ ; y is 0-6; and V is a linker group. Examples of substituents on the aliphatic group or the phenyl ring of  $R^\circ$  include amino, alkylamino, dialkylamino, aminocarbonyl, halogen, alkyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkoxy, nitro, cyano, carboxy, alkoxycarbonyl, alkylcarbonyl, hydroxy, haloalkoxy, or haloalkyl.

An aliphatic group or a non-aromatic heterocyclic ring may contain one or more substituents.

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Examples of suitable substituents on the saturated carbon of an aliphatic group or of a non-aromatic heterocyclic ring include those listed above for the unsaturated carbon of an aryl or heteroaryl group and the following:

5 =O, =S, =NNHR<sup>\*</sup>, =NN(R<sup>\*</sup>)<sub>2</sub>, =N-, =NNHC(O)R<sup>\*</sup>, =NNHCO<sub>2</sub>(alkyl), =NNHSO<sub>2</sub>(alkyl), or =NR<sup>\*</sup>, where each R<sup>\*</sup> is independently selected from hydrogen, an unsubstituted aliphatic group or a substituted aliphatic group. Examples of substituents on the aliphatic group include amino, 10 alkylamino, dialkylamino, aminocarbonyl, halogen, alkyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkoxy, nitro, cyano, carboxy, alkoxycarbonyl, alkylcarbonyl, hydroxy, haloalkoxy, or haloalkyl.

15           Suitable substituents on the nitrogen of a non-aromatic heterocyclic ring include -R<sup>+</sup>, -N(R<sup>+</sup>)<sub>2</sub>, -C(O)R<sup>+</sup>, -CO<sub>2</sub>R<sup>+</sup>, -C(O)C(O)R<sup>+</sup>, -C(O)CH<sub>2</sub>C(O)R<sup>+</sup>, -SO<sub>2</sub>R<sup>+</sup>, -SO<sub>2</sub>N(R<sup>+</sup>)<sub>2</sub>, -C(=S)N(R<sup>+</sup>)<sub>2</sub>, -C(=NH)-N(R<sup>+</sup>)<sub>2</sub>, and -NR<sup>+</sup>SO<sub>2</sub>R<sup>+</sup>; wherein R<sup>+</sup> is hydrogen, an aliphatic group, a substituted aliphatic 20 group, phenyl (Ph), substituted Ph, -O(Ph), substituted -O(Ph), CH<sub>2</sub>(Ph), substituted CH<sub>2</sub>(Ph), or an unsubstituted heteroaryl or heterocyclic ring. Examples of substituents on the aliphatic group or the phenyl ring include amino, alkylamino, dialkylamino, aminocarbonyl, 25 halogen, alkyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkoxy, nitro, cyano, carboxy, alkoxycarbonyl, alkylcarbonyl, hydroxy, haloalkoxy, or haloalkyl.

30           The term "linker group" or "linker" means an organic moiety that connects two parts of a compound. Linkers are typically comprised of an atom such as oxygen or sulfur, a unit such as -NH-, -CH<sub>2</sub>-, -C(O)-, -C(O)NH-, or a chain of atoms, such as an alkylidene chain. The

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molecular mass of a linker is typically in the range of about 14 to 200, preferably in the range of 14 to 96 with a length of up to about six atoms. Examples of linkers include a saturated or unsaturated C<sub>1-6</sub> alkylidene chain which is optionally substituted, and wherein one or two saturated carbons of the chain are optionally replaced by -C(O)-, -C(O)C(O)-, -CONH-, -CONHNH-, -CO<sub>2</sub>-, -OC(O)-, -NHCO<sub>2</sub>-, -O-, -NHCONH-, -OC(O)NH-, -NHNH-, -NHCO-, -S-, -SO-, -SO<sub>2</sub>-, -NH-, -SO<sub>2</sub>NH-, or -NHSO<sub>2</sub>-.

The term "alkylidene chain" refers to an optionally substituted, straight or branched carbon chain that may be fully saturated or have one or more units of unsaturation. The optional substituents are as described above for an aliphatic group.

A combination of substituents or variables is permissible only if such a combination results in a stable or chemically feasible compound. A stable compound or chemically feasible compound is one in which the chemical structure is not substantially altered when kept at a temperature of 40 °C or less, in the absence of moisture or other chemically reactive conditions, for at least a week.

Unless otherwise stated, structures depicted herein are also meant to include all stereochemical forms of the structure; i.e., the R and S configurations for each asymmetric center. Therefore, single stereochemical isomers as well as enantiomeric and diastereomeric mixtures of the present compounds are within the scope of the invention. Unless otherwise stated, structures depicted herein are also meant to include compounds which differ only in the presence of one or more isotopically enriched atoms. For example, compounds having the present structures except for the replacement of a

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hydrogen by a deuterium or tritium, or the replacement of a carbon by a  $^{13}\text{C}$ - or  $^{14}\text{C}$ -enriched carbon are within the scope of this invention.

Compounds of formula I or salts thereof may be formulated into compositions. In a preferred embodiment, the composition is a pharmaceutical composition. In one embodiment, the composition comprises an amount of the protein kinase inhibitor effective to inhibit a protein kinase, particularly Aurora-2, in a biological sample or in a patient. In another embodiment, compounds of this invention and pharmaceutical compositions thereof, which comprise an amount of the protein kinase inhibitor effective to treat or prevent an Aurora-2-mediated condition and a pharmaceutically acceptable carrier, adjuvant, or vehicle, may be formulated for administration to a patient.

Another aspect of this invention relates to a method of treating or preventing an Aurora-2-mediated disease with an Aurora-2 inhibitor, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a compound of formula I or a pharmaceutical composition thereof.

The term "Aurora-2-mediated condition" or "disease", as used herein, means any disease or other deleterious condition in which Aurora is known to play a role. The term "Aurora-2-mediated condition" or "disease" also means those diseases or conditions that are alleviated by treatment with an Aurora-2 inhibitor. Such conditions include, without limitation, cancer. The term "cancer" includes, but is not limited to the following cancers: colon, breast, stomach, and ovarian.

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Another aspect of the invention relates to inhibiting Aurora-2 activity in a biological sample, which method comprises contacting the biological sample with the Aurora-2 inhibitor of formula I, or a composition thereof.

Another aspect of this invention relates to a method of inhibiting Aurora-2 activity in a patient, which method comprises administering to the patient a compound of formula I or a composition comprising said compound.

Another aspect of this invention relates to a method of treating or preventing a GSK-3-mediated disease with a GSK-3 inhibitor, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a compound of formula I or a pharmaceutical composition thereof.

The term "GSK-3-mediated condition" or "disease", as used herein, means any disease or other deleterious condition or state in which GSK-3 is known to play a role. Such diseases or conditions include, without limitation, diabetes, Alzheimer's disease, Huntington's Disease, Parkinson's Disease, AIDS-associated dementia, amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), schizophrenia, cardiomyocyte hypertrophy, reperfusion/ischemia, and baldness.

One aspect of this invention relates to a method of enhancing glycogen synthesis and/or lowering blood levels of glucose in a patient in need thereof, which method comprises administering to the patient a therapeutically effective amount of a compound of formula I or a pharmaceutical composition thereof. This method is especially useful for diabetic patients. Another method relates to inhibiting the production of

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hyperphosphorylated Tau protein, which is useful in halting or slowing the progression of Alzheimer's disease. Another method relates to inhibiting the phosphorylation of  $\beta$ -catenin, which is useful for  
5 treating schizophrenia.

Another aspect of the invention relates to inhibiting GSK-3 activity in a biological sample, which method comprises contacting the biological sample with a GSK-3 inhibitor of formula I.

10 Another aspect of this invention relates to a method of inhibiting GSK-3 activity in a patient, which method comprises administering to the patient a compound of formula I or a composition comprising said compound.

The term "pharmaceutically acceptable carrier, 15 adjuvant, or vehicle" refers to a non-toxic carrier, adjuvant, or vehicle that may be administered to a patient, together with a compound of this invention, and which does not destroy the pharmacological activity thereof.

20 The term "patient" includes human and veterinary subjects.

The term "biological sample", as used herein, includes, without limitation, cell cultures or extracts thereof; preparations of an enzyme suitable for *in vitro* 25 assay; biopsied material obtained from a mammal or extracts thereof; and blood, saliva, urine, feces, semen, tears, or other body fluids or extracts thereof.

The amount effective to inhibit protein kinase, for example, Aurora-2 and GSK-3, is one that measurably 30 inhibits the kinase activity where compared to the activity of the enzyme in the absence of an inhibitor. Any method may be used to determine inhibition, such as,



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for example, the Biological Testing Examples described below.

Pharmaceutically acceptable carriers that may be used in these pharmaceutical compositions include, but  
5 are not limited to, ion exchangers, alumina, aluminum stearate, lecithin, serum proteins, such as human serum albumin, buffer substances such as phosphates, glycine, sorbic acid, potassium sorbate, partial glyceride mixtures of saturated vegetable fatty acids, water, salts  
10 or electrolytes, such as protamine sulfate, disodium hydrogen phosphate, potassium hydrogen phosphate, sodium chloride, zinc salts, colloidal silica, magnesium trisilicate, polyvinyl pyrrolidone, cellulose-based substances, polyethylene glycol, sodium  
15 carboxymethylcellulose, polyacrylates, waxes, polyethylene-polyoxypropylene-block polymers, polyethylene glycol and wool fat.

The compositions of the present invention may be administered orally, parenterally, by inhalation  
20 spray, topically, rectally, nasally, buccally, vaginally or via an implanted reservoir. The term "parenteral" as used herein includes subcutaneous, intravenous, intramuscular, intra-articular, intra-synovial, intrasternal, intrathecal, intrahepatic, intralesional  
25 and intracranial injection or infusion techniques. Preferably, the compositions are administered orally, intraperitoneally or intravenously.

Sterile injectable forms of the compositions of this invention may be aqueous or oleaginous suspension.  
30 These suspensions may be formulated according to techniques known in the art using suitable dispersing or wetting agents and suspending agents. The sterile injectable preparation may also be a sterile injectable

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solution or suspension in a non-toxic parenterally-acceptable diluent or solvent, for example as a solution in 1,3-butanediol. Among the acceptable vehicles and solvents that may be employed are water, Ringer's  
5 solution and isotonic sodium chloride solution. In addition, sterile, fixed oils are conventionally employed as a solvent or suspending medium. For this purpose, any bland fixed oil may be employed including synthetic mono- or di-glycerides. Fatty acids, such as oleic acid and  
10 its glyceride derivatives are useful in the preparation of injectables, as are natural pharmaceutically-acceptable oils, such as olive oil or castor oil, especially in their polyoxyethylated versions. These oil solutions or suspensions may also contain a long-chain  
15 alcohol diluent or dispersant, such as carboxymethyl cellulose or similar dispersing agents which are commonly used in the formulation of pharmaceutically acceptable dosage forms including emulsions and suspensions. Other commonly used surfactants, such as Tweens, Spans and  
20 other emulsifying agents or bioavailability enhancers which are commonly used in the manufacture of pharmaceutically acceptable solid, liquid, or other dosage forms may also be used for the purposes of formulation.

25           The pharmaceutical compositions of this invention may be orally administered in any orally acceptable dosage form including, but not limited to, capsules, tablets, aqueous suspensions or solutions. In the case of tablets for oral use, carriers commonly used  
30 include lactose and corn starch. Lubricating agents, such as magnesium stearate, are also typically added. For oral administration in a capsule form, useful diluents include lactose and dried cornstarch. When

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aqueous suspensions are required for oral use, the active ingredient is combined with emulsifying and suspending agents. If desired, certain sweetening, flavoring or coloring agents may also be added.

5                   Alternatively, the pharmaceutical compositions of this invention may be administered in the form of suppositories for rectal administration. These can be prepared by mixing the agent with a suitable non-irritating excipient which is solid at room temperature  
10 but liquid at rectal temperature and therefore will melt in the rectum to release the drug. Such materials include cocoa butter, beeswax and polyethylene glycols.

                  The pharmaceutical compositions of this invention may also be administered topically, especially  
15 when the target of treatment includes areas or organs readily accessible by topical application, including diseases of the eye, the skin, or the lower intestinal tract. Suitable topical formulations are readily prepared for each of these areas or organs.

20                   Topical application for the lower intestinal tract can be effected in a rectal suppository formulation (see above) or in a suitable enema formulation. Topically-transdermal patches may also be used.

                  For topical applications, the pharmaceutical  
25 compositions may be formulated in a suitable ointment containing the active component suspended or dissolved in one or more carriers. Carriers for topical administration of the compounds of this invention include, but are not limited to, mineral oil, liquid  
30 petrolatum, white petrolatum, propylene glycol, polyoxyethylene, polyoxypropylene compound, emulsifying wax and water. Alternatively, the pharmaceutical compositions can be formulated in a suitable lotion or

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cream containing the active components suspended or dissolved in one or more pharmaceutically acceptable carriers. Suitable carriers include, but are not limited to, mineral oil, sorbitan monostearate, polysorbate 60, 5 cetyl esters wax, cetearyl alcohol, 2-octyldodecanol, benzyl alcohol and water.

For ophthalmic use, the pharmaceutical compositions may be formulated as micronized suspensions in isotonic, pH adjusted sterile saline, or, preferably, 10 as solutions in isotonic, pH adjusted sterile saline, either with or without a preservative such as benzylalkonium chloride. Alternatively, for ophthalmic uses, the pharmaceutical compositions may be formulated in an ointment such as petrolatum.

15 The pharmaceutical compositions of this invention may also be administered by nasal aerosol or inhalation. Such compositions are prepared according to techniques well-known in the art of pharmaceutical formulation and may be prepared as solutions in saline, 20 employing benzyl alcohol or other suitable preservatives, absorption promoters to enhance bioavailability, fluorocarbons, and/or other conventional solubilizing or dispersing agents.

In addition to the compounds of this invention, 25 pharmaceutically acceptable derivatives or prodrugs of the compounds of this invention may also be employed in compositions to treat or prevent the above-identified diseases or disorders.

A "pharmaceutically acceptable derivative or 30 prodrug" means any pharmaceutically acceptable salt, ester, salt of an ester or other derivative of a compound of this invention which, upon administration to a recipient, is capable of providing, either directly or

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indirectly, a compound of this invention or an inhibitorily active metabolite or residue thereof. Particularly favored derivatives or prodrugs are those that increase the bioavailability of the compounds of this invention when such compounds are administered to a patient (e.g., by allowing an orally administered compound to be more readily absorbed into the blood) or which enhance delivery of the parent compound to a biological compartment (e.g., the brain or lymphatic system) relative to the parent species.

Pharmaceutically acceptable prodrugs of the compounds of this invention include, without limitation, esters, amino acid esters, phosphate esters, metal salts and sulfonate esters.

Pharmaceutically acceptable salts of the compounds of this invention include those derived from pharmaceutically acceptable inorganic and organic acids and bases. Examples of suitable acid salts include acetate, adipate, alginate, aspartate, benzoate, benzenesulfonate, bisulfate, butyrate, citrate, camphorate, camphorsulfonate, cyclopentanepropionate, digluconate, dodecylsulfate, ethanesulfonate, formate, fumarate, glucoheptanoate, glycerophosphate, glycolate, hemisulfate, heptanoate, hexanoate, hydrochloride, hydrobromide, hydriodide, 2-hydroxyethanesulfonate, lactate, maleate, malonate, methanesulfonate, 2-naphthalenesulfonate, nicotinate, nitrate, oxalate, palmoate, pectinate, persulfate, 3-phenylpropionate, phosphate, picrate, pivalate, propionate, salicylate, succinate, sulfate, tartrate, thiocyanate, tosylate and undecanoate. Other acids, such as oxalic, while not in themselves pharmaceutically acceptable, may be employed in the preparation of salts useful as intermediates in

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obtaining the compounds of the invention and their pharmaceutically acceptable acid addition salts.

Salts derived from appropriate bases include alkali metal (e.g., sodium and potassium), alkaline earth metal (e.g., magnesium), ammonium and  $N^+(C_{1-4} \text{ alkyl})_4$  salts. This invention also envisions the quaternization of any basic nitrogen-containing groups of the compounds disclosed herein. Water or oil-soluble or dispersible products may be obtained by such quaternization.

10           The amount of the protein kinase inhibitor that may be combined with the carrier materials to produce a single dosage form will vary depending upon the patient treated and the particular mode of administration. Preferably, the compositions should be formulated so that  
15   a dosage of between 0.01 - 100 mg/kg body weight/day of the inhibitor can be administered to a patient receiving these compositions.

          It should also be understood that a specific dosage and treatment regimen for any particular patient  
20   will depend upon a variety of factors, including the activity of the specific compound employed, the age, body weight, general health, sex, diet, time of administration, rate of excretion, drug combination, and the judgment of the treating physician and the severity  
25   of the particular disease being treated. The amount of the inhibitor will also depend upon the particular compound in the composition.

          Depending upon the particular protein kinase-mediated condition to be treated or prevented, additional  
30   therapeutic agents, which are normally administered to treat or prevent that condition, may be administered together with the inhibitors of this invention. For example, in the treatment of cancer other

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chemotherapeutic agents or other anti-proliferative agents may be combined with the Aurora-2 inhibitors of this invention to treat cancer. These agents include, without limitation, adriamycin, dexamethasone,  
5 vincristine, cyclophosphamide, fluorouracil, topotecan, taxol, interferons, and platinum derivatives.

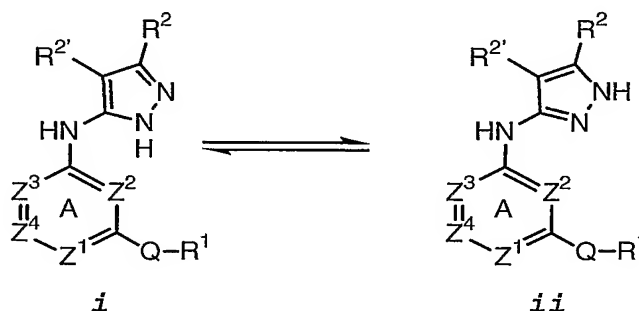
Other examples of agents the inhibitors of this invention may also be combined with include, without limitation, agents for treating diabetes such as insulin  
10 or insulin analogues, in injectable or inhalation form, glitazones, alpha glucosidase inhibitors, biguanides, insulin sensitizers, and sulfonyl ureas; anti-inflammatory agents such as corticosteroids, TNF blockers, IL-1 RA, azathioprine, cyclophosphamide, and  
15 sulfasalazine; immunomodulatory and immunosuppressive agents such as cyclosporin, tacrolimus, rapamycin, mycophenolate mofetil, interferons, corticosteroids, cyclophosphamide, azathioprine, and sulfasalazine; neurotrophic factors such as acetylcholinesterase  
20 inhibitors, MAO inhibitors, interferons, anti-convulsants, ion channel blockers, riluzole, and anti-Parkinsonian agents; agents for treating cardiovascular disease such as beta-blockers, ACE inhibitors, diuretics, nitrates, calcium channel blockers, and statins; agents  
25 for treating liver disease such as corticosteroids, cholestyramine, interferons, and anti-viral agents; agents for treating blood disorders such as corticosteroids, anti-leukemic agents, and growth factors; and agents for treating immunodeficiency  
30 disorders such as gamma globulin.

Those additional agents may be administered separately from the protein kinase inhibitor-containing composition, as part of a multiple dosage regimen.

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Alternatively, those agents may be part of a single dosage form, mixed together with the protein kinase inhibitor of this invention in a single composition.

Compounds of this invention may exist in  
 5 alternative tautomeric forms, as in tautomers *i* and *ii* shown below. Unless otherwise indicated, the representation of either tautomer is meant to include the other.



Preferred  $R^x$  groups, when present, include  
 10 hydrogen, alkyl- or dialkylamino, acetamido, or a  $C_{1-4}$  aliphatic group such as methyl, ethyl, cyclopropyl, or isopropyl.

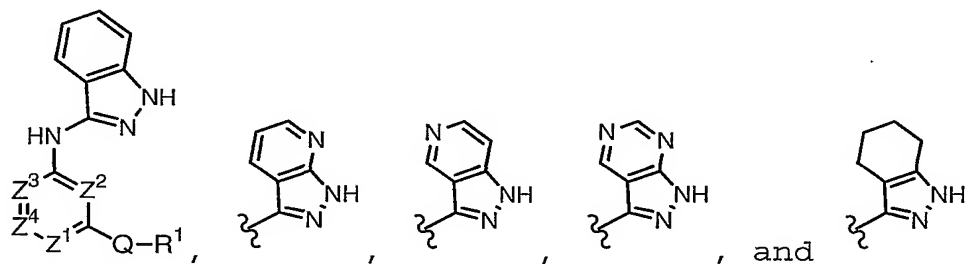
Preferred  $R^y$  groups, when present, include  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$   
 15 aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein Z is a methylene and  $R^{3'}$  is  $-N(R^4)_2$ ,  $-OR$ , or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring  
 20 atoms. Preferred  $R^y$  groups include 5-6 membered heteroaryl or heterocyclyl rings, such as 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, or piperazinyl;  $C_{1-6}$  aliphatic, such as methyl, ethyl, cyclopropyl, isopropyl, or t-butyl; alkoxyalkylamino such



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as methoxyethylamino;, alkoxyalkyl such as methoxymethyl or methoxyethyl; alkyl- or dialkylamino such as ethylamino or dimethylamino; alkyl- or dialkylaminoalkoxy such as dimethylaminopropoxy; acetamido; and optionally  
 5 substituted phenyl such as phenyl or halo-substituted phenyl.

$R^2$  and  $R^{2'}$  may be taken together to form a fused ring, thus providing a bicyclic ring system containing a pyrazole ring. Preferred fused rings include benzo,  
 10 pyrido, pyrimido, and a partially unsaturated 6-membered carbocyclo ring, wherein said fused ring is optionally substituted. These are exemplified in the following formula I compounds having a pyrazole-containing bicyclic ring system:



15 Preferred substituents on the  $R^2/R^{2'}$  fused ring include one or more of the following: -halo,  $-N(R^4)_2$ ,  $-C_{1-3}$  alkyl,  $-C_{1-3}$  haloalkyl,  $-NO_2$ ,  $-O(C_{1-3}$  alkyl),  $-CO_2(C_{1-3}$  alkyl),  $-CN$ ,  $-SO_2(C_{1-3}$  alkyl),  $-SO_2NH_2$ ,  $-OC(O)NH_2$ ,  $-NH_2SO_2(C_{1-3}$  alkyl),  $-NHC(O)(C_{1-3}$  alkyl),  $-C(O)NH_2$ , and  
 20  $-CO(C_{1-3}$  alkyl), wherein the  $(C_{1-3}$  alkyl) is most preferably methyl.

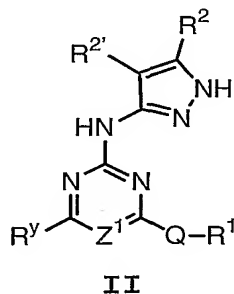
When the pyrazole ring system is monocyclic, preferred  $R^2$  groups include hydrogen,  $C_{1-4}$  aliphatic, alkoxy carbonyl, (un)substituted phenyl, hydroxyalkyl,  
 25 alkoxyalkyl, aminocarbonyl, mono- or

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dialkylaminocarbonyl, aminoalkyl, alkylaminoalkyl, dialkylaminoalkyl, phenylaminocarbonyl, and (N-heterocyclyl)carbonyl. Examples of such preferred R<sup>2</sup> substituents include methyl, cyclopropyl, ethyl, isopropyl, propyl, t-butyl, cyclopentyl, phenyl, CO<sub>2</sub>H, CO<sub>2</sub>CH<sub>3</sub>, CH<sub>2</sub>OH, CH<sub>2</sub>OCH<sub>3</sub>, CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH, CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OCH<sub>3</sub>, CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OCH<sub>2</sub>Ph, CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub>, CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NHCOOC(CH<sub>3</sub>)<sub>3</sub>, CONHCH(CH<sub>3</sub>)<sub>2</sub>, CONHCH<sub>2</sub>CH=CH<sub>2</sub>, CONHCH<sub>2</sub>CH<sub>2</sub>OCH<sub>3</sub>, CONHCH<sub>2</sub>Ph, CONH(cyclohexyl), CON(Et)<sub>2</sub>, CON(CH<sub>3</sub>)CH<sub>2</sub>Ph, CONH(n-C<sub>3</sub>H<sub>7</sub>), CON(Et)CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>, CONHCH<sub>2</sub>CH(CH<sub>3</sub>)<sub>2</sub>, CON(n-C<sub>3</sub>H<sub>7</sub>)<sub>2</sub>, CO(3-methoxymethylpyrrolidin-1-yl), CONH(3-tolyl), CONH(4-tolyl), CONHCH<sub>3</sub>, CO(morpholin-1-yl), CO(4-methylpiperazin-1-yl), CONHCH<sub>2</sub>CH<sub>2</sub>OH, CONH<sub>2</sub>, and CO(piperidin-1-yl). A preferred R<sup>2'</sup> group is hydrogen.

Preferred Q groups of formula I include -S-, -NH-, and -CH<sub>2</sub>-. More preferred Q groups of formula I include -S- and -NH-.

Another embodiment of this invention relates to compounds of formula II:



or a pharmaceutically acceptable derivative or prodrug thereof, wherein:

Z<sup>1</sup> is nitrogen or CR<sup>8</sup>;

R<sup>y</sup> is Z-R<sup>3'</sup> or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10

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ring atoms, or  $R^y$  and  $R^8$  are taken together to form a fused, optionally substituted 5-7 membered, unsaturated or partially unsaturated, ring having 0-3 ring heteroatoms selected from nitrogen, oxygen, or sulfur;

5 Q is selected from  $-N(R^4)-$ ,  $-O-$ ,  $-S-$ , or  $-CH(R^6)-$ ;

$R^1$  is T-(Ring D);

Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl, said heteroaryl or

10 heterocyclyl ring having 1-4 ring heteroatoms selected from nitrogen, oxygen or sulfur, wherein each substitutable ring carbon of Ring D is independently substituted by oxo,  $T-R^5$ , or  $V-Z-R^5$ , and each substitutable ring nitrogen of Ring D is independently

15 substituted by  $-R^4$ ;

T is a valence bond or a  $C_{1-4}$  alkylidene chain, wherein when Q is  $-CH(R^6)-$ , a methylene unit of said  $C_{1-4}$  alkylidene chain is optionally replaced by  $-O-$ ,  $-S-$ ,  $-N(R^4)-$ ,  $-CO-$ ,  $-CONH-$ ,  $-NHCO-$ ,  $-SO_2-$ ,  $-SO_2NH-$ ,  $-NHSO_2-$ ,

20  $-CO_2-$ ,  $-OC(O)-$ ,  $-OC(O)NH-$ , or  $-NHCO_2-$ ;

Z is a  $C_{1-4}$  alkylidene chain;

L is  $-O-$ ,  $-S-$ ,  $-SO-$ ,  $-SO_2-$ ,  $-N(R^6)SO_2-$ ,  $-SO_2N(R^6)-$ ,  $-N(R^6)-$ ,  $-CO-$ ,  $-CO_2-$ ,  $-N(R^6)CO-$ ,  $-N(R^6)C(O)O-$ ,  $-N(R^6)CON(R^6)-$ ,  $-N(R^6)SO_2N(R^6)-$ ,  $-N(R^6)N(R^6)-$ ,

25  $-C(O)N(R^6)-$ ,  $-OC(O)N(R^6)-$ ,  $-C(R^6)_2O-$ ,  $-C(R^6)_2S-$ ,  $-C(R^6)_2SO-$ ,  $-C(R^6)_2SO_2-$ ,  $-C(R^6)_2SO_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)C(O)-$ ,  $-C(R^6)_2N(R^6)C(O)O-$ ,  $-C(R^6)=NN(R^6)-$ ,  $-C(R^6)=N-O-$ ,  $-C(R^6)_2N(R^6)N(R^6)-$ ,  $-C(R^6)_2N(R^6)SO_2N(R^6)-$ , or  $-C(R^6)_2N(R^6)CON(R^6)-$ ;

30  $R^2$  and  $R^{2'}$  are independently selected from  $-R$ ,  $-T-W-R^6$ , or  $R^2$  and  $R^{2'}$  are taken together with their intervening atoms to form a fused, 5-8 membered, unsaturated or partially unsaturated, ring having 0-3 ring heteroatoms

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selected from nitrogen, oxygen, or sulfur, wherein each substitutable ring carbon of said fused ring formed by  $R^2$  and  $R^{2'}$  is independently substituted by halo, oxo, -CN, -NO<sub>2</sub>, -R<sup>7</sup>, or -V-R<sup>6</sup>, and each substitutable ring nitrogen of said ring formed by  $R^2$  and  $R^{2'}$  is independently substituted by R<sup>4</sup>;

$R^{3'}$  is selected from -halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR, -COCH<sub>2</sub>COR, -NO<sub>2</sub>, -CN, -S(O)R, -S(O)<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>7</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>7</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>7</sup>)COR, -N(R<sup>7</sup>)CO<sub>2</sub>(C<sub>1-6</sub> aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>7</sup>)CON(R<sup>7</sup>)<sub>2</sub>, -N(R<sup>7</sup>)SO<sub>2</sub>N(R<sup>7</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, -OC(=O)N(R<sup>7</sup>)<sub>2</sub>, or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;

each R is independently selected from hydrogen or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;

each R<sup>4</sup> is independently selected from -R<sup>7</sup>, -COR<sup>7</sup>, -CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic), -CON(R<sup>7</sup>)<sub>2</sub>, or -SO<sub>2</sub>R<sup>7</sup>;

each R<sup>5</sup> is independently selected from -R, halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR, -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or -OC(=O)N(R<sup>4</sup>)<sub>2</sub>;

V is -O-, -S-, -SO-, -SO<sub>2</sub>-, -N(R<sup>6</sup>)SO<sub>2</sub>-, -SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -N(R<sup>6</sup>)CO-, -N(R<sup>6</sup>)C(O)O-, -N(R<sup>6</sup>)CON(R<sup>6</sup>)-, -N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(O)N(R<sup>6</sup>)-, -OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-,

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-C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-,  
 -C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, or  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-;

5 W is -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-,  
 -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-,  
 -C(R<sup>6</sup>)OC(O)-, -C(R<sup>6</sup>)OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CO-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-,  
 10 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-, or -CON(R<sup>6</sup>)-;

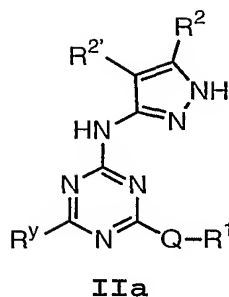
each R<sup>6</sup> is independently selected from hydrogen or an  
 optionally substituted C<sub>1-4</sub> aliphatic group, or two R<sup>6</sup>  
 groups on the same nitrogen atom are taken together  
 with the nitrogen atom to form a 5-6 membered  
 15 heterocyclyl or heteroaryl ring;

each R<sup>7</sup> is independently selected from hydrogen or an  
 optionally substituted C<sub>1-6</sub> aliphatic group, or two R<sup>7</sup>  
 on the same nitrogen are taken together with the  
 nitrogen to form a 5-8 membered heterocyclyl or  
 20 heteroaryl ring; and

R<sup>8</sup> is selected from -R, halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR,  
 -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>,  
 -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)CO<sub>2</sub>(optionally  
 substituted C<sub>1-6</sub> aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>,  
 25 -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or  
 -OC(=O)N(R<sup>4</sup>)<sub>2</sub>; provided that when Q is -NH- and R<sup>y</sup> and  
 R<sup>8</sup> are taken together to form a fused ring, R<sup>1</sup> is other  
 than a pyrazol-3-yl ring or a pyrazol-3-yl-containing  
 bicyclic ring system.

30 Another embodiment of this invention relates to  
 compounds of formula IIa:

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or a pharmaceutically acceptable derivative or prodrug thereof, wherein:

$R^Y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;

$Q$  is selected from  $-N(R^4)-$ ,  $-O-$ ,  $-S-$ , or  $-CH(R^6)-$ ;

$R^1$  is  $T-(\text{Ring D})$ ;

Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl, said heteroaryl or heterocyclyl ring having 1-4 ring heteroatoms selected from nitrogen, oxygen or sulfur, wherein each substitutable ring carbon of Ring D is independently substituted by oxo,  $T-R^5$ , or  $V-Z-R^5$ , and each substitutable ring nitrogen of Ring D is independently substituted by  $-R^4$ ;

$T$  is a valence bond or a  $C_{1-4}$  alkylidene chain, wherein when  $Q$  is  $-CH(R^6)-$ , a methylene unit of said  $C_{1-4}$  alkylidene chain is optionally replaced by  $-O-$ ,  $-S-$ ,  $-N(R^4)-$ ,  $-CO-$ ,  $-CONH-$ ,  $-NHCO-$ ,  $-SO_2-$ ,  $-SO_2NH-$ ,  $-NHSO_2-$ ,  $-CO_2-$ ,  $-OC(O)-$ ,  $-OC(O)NH-$ , or  $-NHCO_2-$ ;

$Z$  is a  $C_{1-4}$  alkylidene chain;

$L$  is  $-O-$ ,  $-S-$ ,  $-SO-$ ,  $-SO_2-$ ,  $-N(R^6)SO_2-$ ,  $-SO_2N(R^6)-$ ,  $-N(R^6)-$ ,  $-CO-$ ,  $-CO_2-$ ,  $-N(R^6)CO-$ ,  $-N(R^6)C(O)O-$ ,  $-N(R^6)CON(R^6)-$ ,  $-N(R^6)SO_2N(R^6)-$ ,  $-N(R^6)N(R^6)-$ ,

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$-C(O)N(R^6)-$ ,  $-OC(O)N(R^6)-$ ,  $-C(R^6)_2O-$ ,  $-C(R^6)_2S-$ ,  
 $-C(R^6)_2SO-$ ,  $-C(R^6)_2SO_2-$ ,  $-C(R^6)_2SO_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)-$ ,  
 $-C(R^6)_2N(R^6)C(O)-$ ,  $-C(R^6)_2N(R^6)C(O)O-$ ,  $-C(R^6)=NN(R^6)-$ ,  
 $-C(R^6)=N-O-$ ,  $-C(R^6)_2N(R^6)N(R^6)-$ ,  $-C(R^6)_2N(R^6)SO_2N(R^6)-$ , or  
 5  $-C(R^6)_2N(R^6)CON(R^6)-$ ;

$R^2$  and  $R^{2'}$  are independently selected from  $-R$ ,  $-T-W-R^6$ , or  
 $R^2$  and  $R^{2'}$  are taken together with their intervening  
 atoms to form a fused, 5-8 membered, unsaturated or  
 partially unsaturated, ring having 0-3 ring heteroatoms  
 10 selected from nitrogen, oxygen, or sulfur, wherein each  
 substitutable ring carbon of said fused ring formed by  
 $R^2$  and  $R^{2'}$  is independently substituted by halo, oxo,  
 $-CN$ ,  $-NO_2$ ,  $-R^7$ , or  $-V-R^6$ , and each substitutable ring  
 nitrogen of said ring formed by  $R^2$  and  $R^{2'}$  is  
 15 independently substituted by  $R^4$ ;

$R^{3'}$  is selected from  $-halo$ ,  $-OR$ ,  $-C(=O)R$ ,  $-CO_2R$ ,  $-COCOR$ ,  
 $-COCH_2COR$ ,  $-NO_2$ ,  $-CN$ ,  $-S(O)R$ ,  $-S(O)_2R$ ,  $-SR$ ,  $-N(R^4)_2$ ,  
 $-CON(R^7)_2$ ,  $-SO_2N(R^7)_2$ ,  $-OC(=O)R$ ,  $-N(R^7)COR$ ,  $-N(R^7)CO_2(C_{1-6}$   
 aliphatic),  $-N(R^4)N(R^4)_2$ ,  $-C=NN(R^4)_2$ ,  $-C=N-OR$ ,  
 20  $-N(R^7)CON(R^7)_2$ ,  $-N(R^7)SO_2N(R^7)_2$ ,  $-N(R^4)SO_2R$ ,  
 $-OC(=O)N(R^7)_2$ , or an optionally substituted group  
 selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl  
 ring having 5-10 ring atoms, or a heterocyclyl ring  
 having 5-10 ring atoms;

25 each  $R$  is independently selected from hydrogen or an  
 optionally substituted group selected from  $C_{1-6}$   
 aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10  
 ring atoms, or a heterocyclyl ring having 5-10 ring  
 atoms;

30 each  $R^4$  is independently selected from  $-R^7$ ,  $-COR^7$ ,  
 $-CO_2$ (optionally substituted  $C_{1-6}$  aliphatic),  $-CON(R^7)_2$ ,  
 or  $-SO_2R^7$ ;

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each  $R^5$  is independently selected from -R, halo, -OR,  
 -C(=O)R, -CO<sub>2</sub>R, -COCOR, -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR,  
 -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR,  
 -N(R<sup>4</sup>)CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic),  
 5 -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>,  
 -N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or -OC(=O)N(R<sup>4</sup>)<sub>2</sub>;

V is -O-, -S-, -SO-, -SO<sub>2</sub>-, -N(R<sup>6</sup>)SO<sub>2</sub>-, -SO<sub>2</sub>N(R<sup>6</sup>)-,  
 -N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -N(R<sup>6</sup>)CO-, -N(R<sup>6</sup>)C(O)O-,  
 -N(R<sup>6</sup>)CON(R<sup>6</sup>)-, -N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)N(R<sup>6</sup>)-,  
 10 -C(O)N(R<sup>6</sup>)-, -OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-,  
 -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-,  
 -C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, or  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-;

15 W is -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-,  
 -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-,  
 -C(R<sup>6</sup>)OC(O)-, -C(R<sup>6</sup>)OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CO-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-,  
 20 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-, or -CON(R<sup>6</sup>)-;

each  $R^6$  is independently selected from hydrogen or an  
 optionally substituted C<sub>1-4</sub> aliphatic group, or two  $R^6$   
 groups on the same nitrogen atom are taken together  
 with the nitrogen atom to form a 5-6 membered

25 heterocyclyl or heteroaryl ring; and

each  $R^7$  is independently selected from hydrogen or an  
 optionally substituted C<sub>1-6</sub> aliphatic group, or two  $R^7$   
 on the same nitrogen are taken together with the  
 nitrogen to form a 5-8 membered heterocyclyl or  
 30 heteroaryl ring.

Preferred  $R^Y$  groups of formula IIa include Z- $R^{3'}$   
 or an optionally substituted group selected from C<sub>1-6</sub>  
 aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6

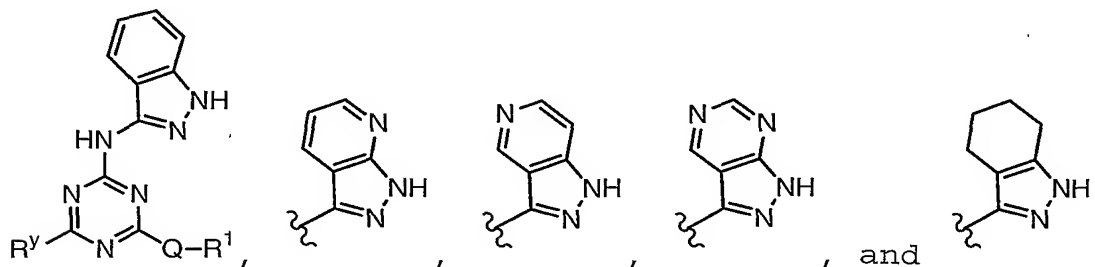


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membered heteroaryl, wherein Z is a methylene and R<sup>3'</sup> is -N(R<sup>4</sup>)<sub>2</sub>, -OR, or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms.

Examples of preferred R<sup>y</sup> groups include 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino such as methoxyethylamino, alkoxyalkyl such as methoxymethyl or methoxyethyl, alkyl- or dialkylamino such as ethylamino or dimethylamino, alkyl- or dialkylaminoalkoxy such as dimethylaminopropoxy, acetamido, optionally substituted phenyl such as phenyl or halo-substituted phenyl.

The R<sup>2</sup> and R<sup>2'</sup> groups of formula IIa may be taken together to form a fused ring, thus providing a bicyclic ring system containing a pyrazole ring. Preferred fused rings include benzo, pyrido, pyrimido, and a partially unsaturated 6-membered carbocyclo ring. These are exemplified in the following formula IIa compounds having a pyrazole-containing bicyclic ring system:



Preferred substituents on the R<sup>2</sup>/R<sup>2'</sup> fused ring of formula IIa include one or more of the following:

-halo, -N(R<sup>4</sup>)<sub>2</sub>, -C<sub>1-4</sub> alkyl, -C<sub>1-4</sub> haloalkyl, -NO<sub>2</sub>, -O(C<sub>1-4</sub>

-37-

alkyl),  $-\text{CO}_2(\text{C}_{1-4} \text{ alkyl})$ ,  $-\text{CN}$ ,  $-\text{SO}_2(\text{C}_{1-4} \text{ alkyl})$ ,  $-\text{SO}_2\text{NH}_2$ ,  
 $-\text{OC}(\text{O})\text{NH}_2$ ,  $-\text{NH}_2\text{SO}_2(\text{C}_{1-4} \text{ alkyl})$ ,  $-\text{NHC}(\text{O})(\text{C}_{1-4} \text{ alkyl})$ ,  
 $-\text{C}(\text{O})\text{NH}_2$ , and  $-\text{CO}(\text{C}_{1-4} \text{ alkyl})$ , wherein the  $(\text{C}_{1-4} \text{ alkyl})$  is a  
straight, branched, or cyclic alkyl group. Preferably,  
5 the  $(\text{C}_{1-4} \text{ alkyl})$  group is methyl.

When the pyrazole ring system of formula **IIa** is monocyclic, preferred  $\text{R}^2$  groups include hydrogen or a substituted or unsubstituted group selected from aryl, heteroaryl, or a  $\text{C}_{1-6}$  aliphatic group. Examples of such  
10 preferred  $\text{R}^2$  groups include H, methyl, ethyl, propyl, , cyclopropyl, i-propyl, cyclopentyl, hydroxypropyl, methoxypropyl, and benzyloxypropyl. A preferred  $\text{R}^{2'}$  group is hydrogen.

When Ring D of formula **IIa** is monocyclic,  
15 preferred Ring D groups include phenyl, pyridyl, pyridazinyl, pyrimidinyl, and pyrazinyl.

When Ring D of formula **IIa** is bicyclic, preferred bicyclic Ring D groups include naphthyl, tetrahydronaphthyl, indanyl, benzimidazolyl, quinolinyl,  
20 indolyl, isoindolyl, indolinyl, benzo[b]furyl, benzo[b]thiophenyl, indazolyl, benzothiazolyl, cinnolinyl, phthalazinyl, quinazolinyl, quinoxazolinyl, 1,8-naphthyridinyl and isoquinolinyl.

On Ring D of formula **IIa**, preferred  $\text{T-R}^5$  or  
25  $\text{V-Z-R}^5$  substituents include -halo,  $-\text{CN}$ ,  $-\text{NO}_2$ ,  $-\text{N}(\text{R}^4)_2$ , optionally substituted  $\text{C}_{1-6}$  aliphatic group,  $-\text{OR}$ ,  $-\text{C}(\text{O})\text{R}$ ,  $-\text{CO}_2\text{R}$ ,  $-\text{CONH}(\text{R}^4)$ ,  $-\text{N}(\text{R}^4)\text{COR}$ ,  $-\text{N}(\text{R}^4)\text{CO}_2\text{R}$ ,  $-\text{SO}_2\text{N}(\text{R}^4)_2$ ,  $-\text{N}(\text{R}^4)\text{SO}_2\text{R}$ ,  $-\text{N}(\text{R}^6)\text{COCH}_2\text{N}(\text{R}^4)_2$ ,  $-\text{N}(\text{R}^6)\text{COCH}_2\text{CH}_2\text{N}(\text{R}^4)_2$ , and  $-\text{N}(\text{R}^6)\text{COCH}_2\text{CH}_2\text{CH}_2\text{N}(\text{R}^4)_2$ , wherein R is selected from  
30 hydrogen,  $\text{C}_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring. More preferred  $\text{R}^5$  substituents include  $-\text{Cl}$ ,  $-\text{Br}$ ,  $-\text{F}$ ,  $-\text{CN}$ ,  $-\text{CF}_3$ ,  $-\text{COOH}$ ,  $-\text{CONHMe}$ ,  $-\text{CONH}^t\text{Et}$ ,  $-\text{NH}_2$ ,  $-\text{NHAc}$ ,  $-\text{NH}\text{SO}_2\text{Me}$ ,

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-NHSO<sub>2</sub>Et, -NHSO<sub>2</sub>(n-propyl), -NHSO<sub>2</sub>(isopropyl), -NHCOEt,  
-NHCOCH<sub>2</sub>NHCH<sub>3</sub>, -NHCOCH<sub>2</sub>N(CO<sub>2</sub>t-Bu)CH<sub>3</sub>, -NHCOCH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>,  
-NHCOCH<sub>2</sub>CH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>, -NHCOCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>,  
-NHCO(cyclopropyl), -NHCO(isobutyl), -NHCOCH<sub>2</sub>(morpholin-4-  
5 yl), -NHCOCH<sub>2</sub>CH<sub>2</sub>(morpholin-4-yl), -NHCOCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>(morpholin-  
4-yl), -NHCO<sub>2</sub>(t-butyl), -NH(C<sub>1-4</sub> aliphatic) such as -NHMe,  
-N(C<sub>1-4</sub> aliphatic)<sub>2</sub> such as -NMe<sub>2</sub>, OH, -O(C<sub>1-4</sub> aliphatic)  
such as -OMe, C<sub>1-4</sub> aliphatic such as methyl, ethyl,  
cyclopropyl, isopropyl, or t-butyl, and -CO<sub>2</sub>(C<sub>1-4</sub>  
10 aliphatic).

Preferred formula **IIa** compounds have one or more, and more preferably all, of the features selected from the group consisting of:

- (a) R<sup>y</sup> is Z-R<sup>3'</sup> or an optionally substituted group  
15 selected from C<sub>1-6</sub> aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein Z is a methylene and R<sup>3'</sup> is -N(R<sup>4</sup>)<sub>2</sub>, -OR, or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a  
20 heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;
- (b) R<sup>1</sup> is T-(Ring D), wherein T is a valence bond or a methylene unit;
- (c) Ring D is a 5-7 membered monocyclic or an 8-10  
25 membered bicyclic aryl or heteroaryl ring; and
- (d) R<sup>2</sup> is -R or -T-W-R<sup>6</sup> and R<sup>2'</sup> is hydrogen, or R<sup>2</sup> and R<sup>2'</sup> are taken together to form an optionally substituted benzo ring.

More preferred compounds of formula **IIa** have  
30 one or more, and more preferably all, of the features selected from the group consisting of:

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- (a)  $R^Y$  is an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Q is -S-, -NH-, or -CH<sub>2</sub>-;
- (c) Ring D is a 5-6 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is -R and  $R^{2'}$  is hydrogen, wherein R is selected from hydrogen,  $C_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring.

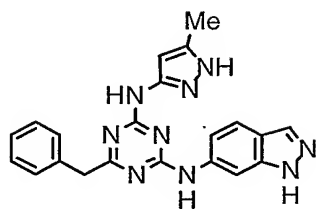
Even more preferred compounds of formula **IIa** have one or more, and more preferably all, of the features selected from the group consisting of:

- (a)  $R^Y$  is selected from 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino, alkoxyalkyl, alkyl- or dialkylamino, alkyl- or dialkylaminoalkoxy, acetamido, optionally substituted phenyl, or methoxymethyl;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Ring D is a 5-6 membered aryl or heteroaryl ring, wherein Ring D is optionally substituted with one to two groups selected from -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted  $C_{1-6}$  aliphatic group, -OR, -CO<sub>2</sub>R, -CONH(R<sup>4</sup>), -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, or -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and Q is -S- or -NH-; and
- (c)  $R^2$  is hydrogen or a substituted or unsubstituted  $C_{1-6}$  aliphatic, and L is -O-, -S-, or -NH-.

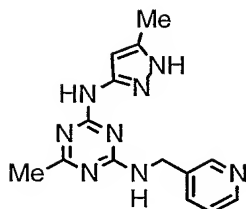
Representative compounds of formula **IIa** are shown below in Table 1.

- 40 -

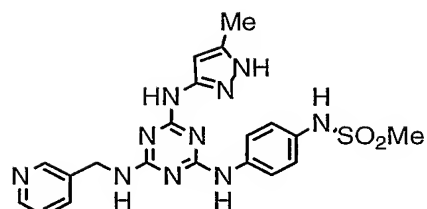
Table 1.



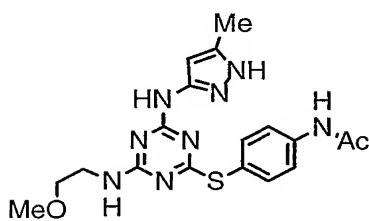
IIa-1



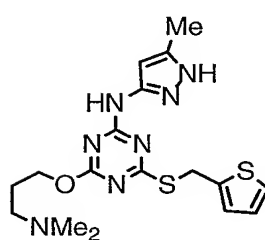
IIa-2



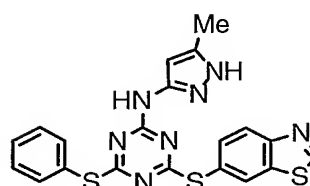
IIa-3



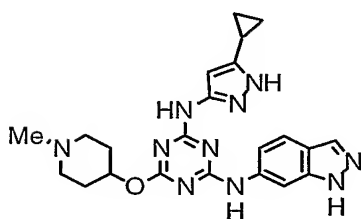
IIa-4



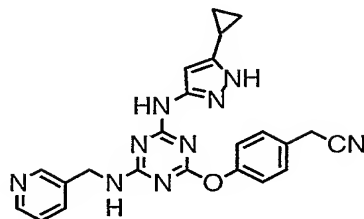
IIa-5



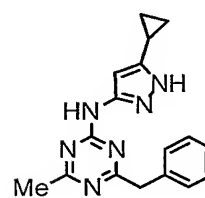
IIa-6



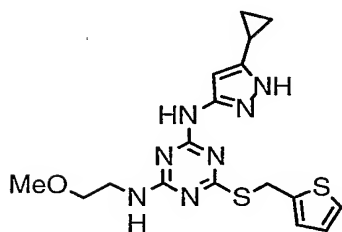
IIa-7



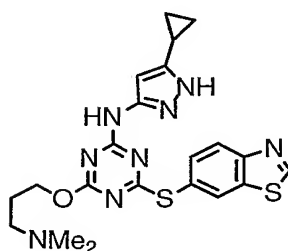
IIa-8



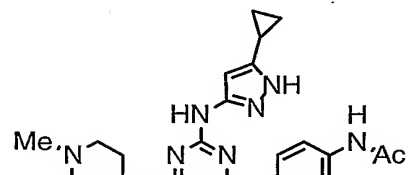
IIa-9



IIa-10

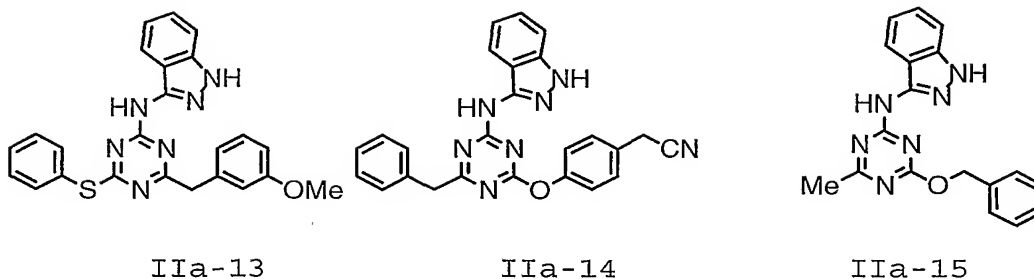


IIa-11



IIa-12

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In another embodiment, this invention provides a composition comprising a compound of formula IIa and a pharmaceutically acceptable carrier.

Another aspect of this invention relates to a  
5 method of treating or preventing an Aurora-2-mediated disease with an Aurora-2 inhibitor, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a compound of formula IIa or a pharmaceutical composition  
10 thereof.

Another aspect of this invention relates to a method of inhibiting Aurora-2 activity in a patient, which method comprises administering to the patient a compound of formula IIa or a composition comprising said  
15 compound.

Another aspect of this invention relates to a method of treating or preventing a GSK-3-mediated disease with a GSK-3 inhibitor, which method comprises administering to a patient in need of such treatment a  
20 therapeutically effective amount of a compound of formula IIa or a pharmaceutical composition thereof.

One aspect of this invention relates to a method of enhancing glycogen synthesis and/or lowering blood levels of glucose in a patient in need thereof, which method comprises administering to the patient a  
25 therapeutically effective amount of a compound of formula

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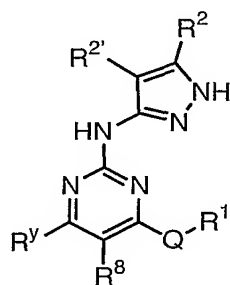
IIa or a pharmaceutical composition thereof. This method is especially useful for diabetic patients. Another method relates to inhibiting the production of hyperphosphorylated Tau protein, which is useful in halting or slowing the progression of Alzheimer's disease. Another method relates to inhibiting the phosphorylation of  $\beta$ -catenin, which is useful for treating schizophrenia.

Another aspect of this invention relates to a method of inhibiting GSK-3 activity in a patient, which method comprises administering to the patient a compound of formula IIa or a composition comprising said compound.

Another method relates to inhibiting Aurora-2 or GSK-3 activity in a biological sample, which method comprises contacting the biological sample with the Aurora-2 or GSK-3 inhibitor of formula IIa, or a pharmaceutical composition thereof, in an amount effective to inhibit Aurora-2 or GSK-3.

Each of the aforementioned methods directed to the inhibition of Aurora-2 or GSK-3, or the treatment of a disease alleviated thereby, is preferably carried out with a preferred compound of formula IIa, as described above.

Another embodiment of this invention relates to compounds of formula IIb:



IIb

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or a pharmaceutically acceptable derivative or prodrug thereof, wherein:

$R^Y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having  
 5 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms, or  $R^Y$  and  $R^8$  are taken together to form a fused, optionally substituted 5-7 membered, unsaturated or partially unsaturated, ring having 0-3 ring heteroatoms selected from nitrogen, oxygen, or sulfur;

10 Q is selected from  $-N(R^4)-$ ,  $-O-$ ,  $-S-$ , or  $-CH(R^6)-$ ;

$R^1$  is T-(Ring D);

Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl, said heteroaryl or  
 15 heterocyclyl ring having 1-4 ring heteroatoms selected from nitrogen, oxygen or sulfur, wherein each substitutable ring carbon of Ring D is independently substituted by oxo,  $T-R^5$ , or  $V-Z-R^5$ , and each substitutable ring nitrogen of Ring D is independently  
 20 substituted by  $-R^4$ ;

T is a valence bond or a  $C_{1-4}$  alkylidene chain, wherein when Q is  $-CH(R^6)-$ , a methylene unit of said  $C_{1-4}$  alkylidene chain is optionally replaced by  $-O-$ ,  $-S-$ ,  $-N(R^4)-$ ,  $-CO-$ ,  $-CONH-$ ,  $-NHCO-$ ,  $-SO_2-$ ,  $-SO_2NH-$ ,  $-NHSO_2-$ ,  
 25  $-CO_2-$ ,  $-OC(O)-$ ,  $-OC(O)NH-$ , or  $-NHCO_2-$ ;

Z is a  $C_{1-4}$  alkylidene chain;

L is  $-O-$ ,  $-S-$ ,  $-SO-$ ,  $-SO_2-$ ,  $-N(R^6)SO_2-$ ,  $-SO_2N(R^6)-$ ,  $-N(R^6)-$ ,  $-CO-$ ,  $-CO_2-$ ,  $-N(R^6)CO-$ ,  $-N(R^6)C(O)O-$ ,  $-N(R^6)CON(R^6)-$ ,  $-N(R^6)SO_2N(R^6)-$ ,  $-N(R^6)N(R^6)-$ ,  
 30  $-C(O)N(R^6)-$ ,  $-OC(O)N(R^6)-$ ,  $-C(R^6)_2O-$ ,  $-C(R^6)_2S-$ ,  $-C(R^6)_2SO-$ ,  $-C(R^6)_2SO_2-$ ,  $-C(R^6)_2SO_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)C(O)-$ ,  $-C(R^6)_2N(R^6)C(O)O-$ ,  $-C(R^6)=NN(R^6)-$ ,



-44-

$-C(R^6)=N-O-$ ,  $-C(R^6)_2N(R^6)N(R^6)-$ ,  $-C(R^6)_2N(R^6)SO_2N(R^6)-$ , or  
 $-C(R^6)_2N(R^6)CON(R^6)-$ ;

$R^2$  and  $R^{2'}$  are independently selected from  $-R$ ,  $-T-W-R^6$ , or

$R^2$  and  $R^{2'}$  are taken together with their intervening  
 5 atoms to form a fused, 5-8 membered, unsaturated or  
 partially unsaturated, ring having 0-3 ring heteroatoms  
 selected from nitrogen, oxygen, or sulfur, wherein each  
 substitutable ring carbon of said fused ring formed by  
 $R^2$  and  $R^{2'}$  is independently substituted by halo, oxo,  
 10  $-CN$ ,  $-NO_2$ ,  $-R^7$ , or  $-V-R^6$ , and each substitutable ring  
 nitrogen of said ring formed by  $R^2$  and  $R^{2'}$  is  
 independently substituted by  $R^4$ ;

$R^{3'}$  is selected from  $-halo$ ,  $-OR$ ,  $-C(=O)R$ ,  $-CO_2R$ ,  $-COCOR$ ,  
 $-COCH_2COR$ ,  $-NO_2$ ,  $-CN$ ,  $-S(O)R$ ,  $-S(O)_2R$ ,  $-SR$ ,  $-N(R^4)_2$ ,  
 15  $-CON(R^7)_2$ ,  $-SO_2N(R^7)_2$ ,  $-OC(=O)R$ ,  $-N(R^7)COR$ ,  $-N(R^7)CO_2(C_{1-6}$   
 aliphatic),  $-N(R^4)N(R^4)_2$ ,  $-C=NN(R^4)_2$ ,  $-C=N-OR$ ,  
 $-N(R^7)CON(R^7)_2$ ,  $-N(R^7)SO_2N(R^7)_2$ ,  $-N(R^4)SO_2R$ ,  
 $-OC(=O)N(R^7)_2$ , or an optionally substituted group  
 selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl  
 20 ring having 5-10 ring atoms, or a heterocyclyl ring  
 having 5-10 ring atoms;

each  $R$  is independently selected from hydrogen or an  
 optionally substituted group selected from  $C_{1-6}$   
 aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10  
 25 ring atoms, or a heterocyclyl ring having 5-10 ring  
 atoms;

each  $R^4$  is independently selected from  $-R^7$ ,  $-COR^7$ ,  
 $-CO_2$ (optionally substituted  $C_{1-6}$  aliphatic),  $-CON(R^7)_2$ ,  
 or  $-SO_2R^7$ ;

30 each  $R^5$  is independently selected from  $-R$ , halo,  $-OR$ ,  
 $-C(=O)R$ ,  $-CO_2R$ ,  $-COCOR$ ,  $-NO_2$ ,  $-CN$ ,  $-S(O)R$ ,  $-SO_2R$ ,  $-SR$ ,  
 $-N(R^4)_2$ ,  $-CON(R^4)_2$ ,  $-SO_2N(R^4)_2$ ,  $-OC(=O)R$ ,  $-N(R^4)COR$ ,  
 $-N(R^4)CO_2$ (optionally substituted  $C_{1-6}$  aliphatic),

-45-

$-N(R^4)N(R^4)_2$ ,  $-C=NN(R^4)_2$ ,  $-C=N-OR$ ,  $-N(R^4)CON(R^4)_2$ ,  
 $-N(R^4)SO_2N(R^4)_2$ ,  $-N(R^4)SO_2R$ , or  $-OC(=O)N(R^4)_2$ ;  
V is  $-O-$ ,  $-S-$ ,  $-SO-$ ,  $-SO_2-$ ,  $-N(R^6)SO_2-$ ,  $-SO_2N(R^6)-$ ,  
 $-N(R^6)-$ ,  $-CO-$ ,  $-CO_2-$ ,  $-N(R^6)CO-$ ,  $-N(R^6)C(O)O-$ ,  
5  $-N(R^6)CON(R^6)-$ ,  $-N(R^6)SO_2N(R^6)-$ ,  $-N(R^6)N(R^6)-$ ,  
 $-C(O)N(R^6)-$ ,  $-OC(O)N(R^6)-$ ,  $-C(R^6)_2O-$ ,  $-C(R^6)_2S-$ ,  
 $-C(R^6)_2SO-$ ,  $-C(R^6)_2SO_2-$ ,  $-C(R^6)_2SO_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)-$ ,  
 $-C(R^6)_2N(R^6)C(O)-$ ,  $-C(R^6)_2N(R^6)C(O)O-$ ,  $-C(R^6)=NN(R^6)-$ ,  
 $-C(R^6)=N-O-$ ,  $-C(R^6)_2N(R^6)N(R^6)-$ ,  $-C(R^6)_2N(R^6)SO_2N(R^6)-$ , or  
10  $-C(R^6)_2N(R^6)CON(R^6)-$ ;  
W is  $-C(R^6)_2O-$ ,  $-C(R^6)_2S-$ ,  $-C(R^6)_2SO-$ ,  $-C(R^6)_2SO_2-$ ,  
 $-C(R^6)_2SO_2N(R^6)-$ ,  $-C(R^6)_2N(R^6)-$ ,  $-CO-$ ,  $-CO_2-$ ,  
 $-C(R^6)OC(O)-$ ,  $-C(R^6)OC(O)N(R^6)-$ ,  $-C(R^6)_2N(R^6)CO-$ ,  
 $-C(R^6)_2N(R^6)C(O)O-$ ,  $-C(R^6)=NN(R^6)-$ ,  $-C(R^6)=N-O-$ ,  
15  $-C(R^6)_2N(R^6)N(R^6)-$ ,  $-C(R^6)_2N(R^6)SO_2N(R^6)-$ ,  
 $-C(R^6)_2N(R^6)CON(R^6)-$ , or  $-CON(R^6)-$ ;  
each  $R^6$  is independently selected from hydrogen or an  
optionally substituted  $C_{1-4}$  aliphatic group, or two  $R^6$   
groups on the same nitrogen atom are taken together  
20 with the nitrogen atom to form a 5-6 membered  
heterocyclyl or heteroaryl ring;  
each  $R^7$  is independently selected from hydrogen or an  
optionally substituted  $C_{1-6}$  aliphatic group, or two  $R^7$   
on the same nitrogen are taken together with the  
25 nitrogen to form a 5-8 membered heterocyclyl or  
heteroaryl ring; and  
 $R^8$  is selected from  $-R$ , halo,  $-OR$ ,  $-C(=O)R$ ,  $-CO_2R$ ,  $-COCOR$ ,  
 $-NO_2$ ,  $-CN$ ,  $-S(O)R$ ,  $-SO_2R$ ,  $-SR$ ,  $-N(R^4)_2$ ,  $-CON(R^4)_2$ ,  
 $-SO_2N(R^4)_2$ ,  $-OC(=O)R$ ,  $-N(R^4)COR$ ,  $-N(R^4)CO_2$  (optionally  
30 substituted  $C_{1-6}$  aliphatic),  $-N(R^4)N(R^4)_2$ ,  $-C=NN(R^4)_2$ ,  
 $-C=N-OR$ ,  $-N(R^4)CON(R^4)_2$ ,  $-N(R^4)SO_2N(R^4)_2$ ,  $-N(R^4)SO_2R$ , or  
 $-OC(=O)N(R^4)_2$ ; provided that when Q is  $-NH-$  and  $R^y$  and  
 $R^8$  are taken together to form a fused ring,  $R^1$  is other

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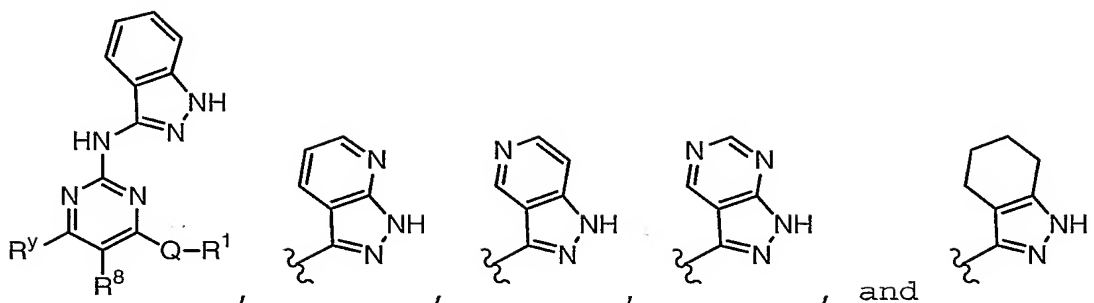
than a pyrazol-3-yl ring or a pyrazol-3-yl-containing bicyclic ring system.

Preferred  $R^Y$  groups of formula **IIb** include  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein Z is a methylene and  $R^{3'}$  is  $-N(R^4)_2$ ,  $-OR$ , or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms..

Examples of preferred  $R^Y$  groups include 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino such as methoxyethylamino, alkoxyalkyl such as methoxymethyl or methoxyethyl, alkyl- or dialkylamino such as ethylamino or dimethylamino, alkyl- or dialkylaminoalkoxy such as dimethylaminopropoxy, acetamido, optionally substituted phenyl such as phenyl or halo-substituted phenyl.

The  $R^2$  and  $R^{2'}$  groups of formula **IIb** may be taken together to form a fused ring, thus providing a bicyclic ring system containing a pyrazole ring. Preferred fused rings include benzo, pyrido, pyrimido, and a partially unsaturated 6-membered carbocyclo ring. These are exemplified in the following formula **IIb** compounds having a pyrazole-containing bicyclic ring system:

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Preferred substituents on the  $R^2/R^{2'}$  fused ring of formula **IIb** include one or more of the following:

- halo,  $-N(R^4)_2$ ,  $-C_{1-4}$  alkyl,  $-C_{1-4}$  haloalkyl,  $-NO_2$ ,  $-O(C_{1-4}$  alkyl),  $-CO_2(C_{1-4}$  alkyl),  $-CN$ ,  $-SO_2(C_{1-4}$  alkyl),  $-SO_2NH_2$ ,
- 5  $-OC(O)NH_2$ ,  $-NH_2SO_2(C_{1-4}$  alkyl),  $-NHC(O)(C_{1-4}$  alkyl),  $-C(O)NH_2$ , and  $-CO(C_{1-4}$  alkyl), wherein the  $(C_{1-4}$  alkyl) is a straight, branched, or cyclic alkyl group. Preferably, the  $(C_{1-4}$  alkyl) group is methyl.

When the pyrazole ring system of formula **IIb** is  
 10 monocyclic, preferred  $R^2$  groups include hydrogen or a substituted or unsubstituted group selected from aryl, heteroaryl, or a  $C_{1-6}$  aliphatic group. Examples of such preferred  $R^2$  groups include H, methyl, ethyl, propyl, , cyclopropyl, i-propyl, cyclopentyl, hydroxypropyl,  
 15 methoxypropyl, and benzyloxypropyl. A preferred  $R^{2'}$  group is hydrogen.

When Ring D of formula **IIb** is monocyclic, preferred Ring D groups include phenyl, pyridyl, pyridazinyl, pyrimidinyl, and pyrazinyl.

20 When Ring D of formula **IIb** is bicyclic, preferred bicyclic Ring D groups include naphthyl, tetrahydronaphthyl, indanyl, benzimidazolyl, quinolinyl, indolyl, isoindolyl, indolinyl, benzo[b]furyl, benzo[b]thiophenyl, indazolyl, benzothiazolyl,  
 25 cinnolinyl, phthalazinyl, quinazolinyl, quinoxazolinyl, 1,8-naphthyridinyl and isoquinolinyl.

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On Ring D of formula **IIb**, preferred T-R<sup>5</sup> or V-Z-R<sup>5</sup> substituents include -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted C<sub>1-6</sub> aliphatic group, -OR, -C(O)R, -CO<sub>2</sub>R, -CONH(R<sup>4</sup>), -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)CO<sub>2</sub>R, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>,  
5 -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, wherein R is selected from hydrogen, C<sub>1-6</sub> aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring. More preferred R<sup>5</sup> substituents include -Cl, -Br, -F, -CN,  
10 -CF<sub>3</sub>, -COOH, -CONHMe, -CONHEt, -NH<sub>2</sub>, -NHAc, -NHSO<sub>2</sub>Me, -NHSO<sub>2</sub>Et, -NHSO<sub>2</sub>(n-propyl), -NHSO<sub>2</sub>(isopropyl), -NHCOEt, -NHCOCH<sub>2</sub>NHCH<sub>3</sub>, -NHCOCH<sub>2</sub>N(CO<sub>2</sub>t-Bu)CH<sub>3</sub>, -NHCOCH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>, -NHCOCH<sub>2</sub>CH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>, -NHCOCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>, -NHCO(cyclopropyl), -NHCO(isobutyl), -NHCOCH<sub>2</sub>(morpholin-4-yl),  
15 -NHCOCH<sub>2</sub>CH<sub>2</sub>(morpholin-4-yl), -NHCOCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>(morpholin-4-yl), -NHCO<sub>2</sub>(t-butyl), -NH(C<sub>1-4</sub> aliphatic) such as -NHMe, -N(C<sub>1-4</sub> aliphatic)<sub>2</sub> such as -NMe<sub>2</sub>, OH, -O(C<sub>1-4</sub> aliphatic) such as -OMe, C<sub>1-4</sub> aliphatic such as methyl, ethyl, cyclopropyl, isopropyl, or t-butyl, and -CO<sub>2</sub>(C<sub>1-4</sub> aliphatic).  
20

When R<sup>y</sup> and R<sup>8</sup> are taken together to form a fused ring, preferred rings formed by R<sup>y</sup> and R<sup>8</sup> include 5-6 membered unsaturated or partially unsaturated rings having 0-2 heteroatoms. More preferred fused rings  
25 formed by R<sup>y</sup> and R<sup>8</sup> include benzo, cyclohexo, and pyrido.

Preferred R<sup>8</sup> groups of formula **IIb**, when present, include R, OR, and N(R<sup>4</sup>)<sub>2</sub>. Examples of preferred R<sup>8</sup> include methyl, ethyl, NH<sub>2</sub>, NH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH, N(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH, N(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>O, (piperidin-1-yl)CH<sub>2</sub>CH<sub>2</sub>O, and NH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>O.

30 Preferred formula **IIb** compounds have one or more, and more preferably all, of the features selected from the group consisting of:

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- 5 (a)  $R^Y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein Z is a methylene and  $R^{3'}$  is  $-N(R^4)_2$ ,  $-OR$ , or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;
- 10 (b)  $R^1$  is  $T-(\text{Ring D})$ , wherein T is a valence bond or a methylene unit;
- (c) Ring D is a 5-7 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is  $-R$  or  $-T-W-R^6$  and  $R^{2'}$  is hydrogen, or  $R^2$  and  $R^{2'}$  are taken together to form an optionally substituted benzo ring.
- 15

More preferred compounds of formula **IIb** have one or more, and more preferably all, of the features selected from the group consisting of:

- 20 (a)  $R^Y$  is an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl;
- (b)  $R^1$  is  $T-(\text{Ring D})$ , wherein T is a valence bond, and Q is  $-S-$ ,  $-NH-$ , or  $-CH_2-$ ;
- 25 (c) Ring D is a 5-6 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is  $-R$  and  $R^{2'}$  is hydrogen, wherein R is selected from hydrogen,  $C_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring.

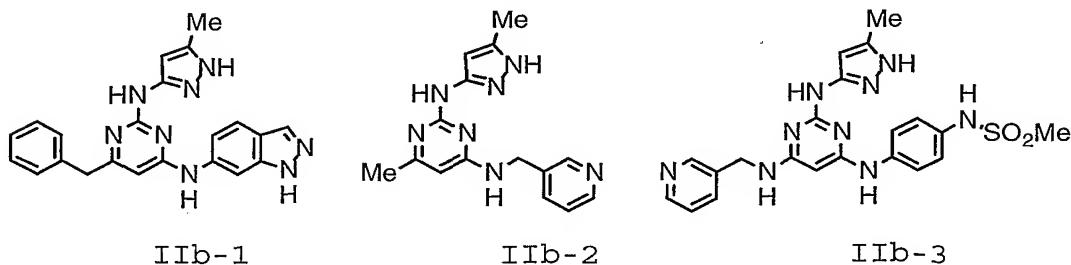
30 Even more preferred compounds of formula **IIb** have one or more, and more preferably all, of the features selected from the group consisting of:

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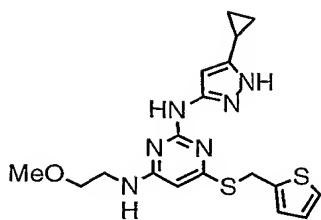
- (a)  $R^y$  is selected from 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino, alkoxyalkyl, alkyl- or dialkylamino, alkyl- or dialkylaminoalkoxy, acetamido, optionally substituted phenyl, or methoxymethyl, or  $R^y$  and  $R^8$  are taken together to form a 5-6 membered unsaturated or partially unsaturated ring having 0-2 heteroatoms selected from nitrogen, oxygen, or sulfur;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Ring D is a 5-6 membered aryl or heteroaryl ring, wherein Ring D is optionally substituted with one to two groups selected from -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted C<sub>1-6</sub> aliphatic group, -OR, -CO<sub>2</sub>R, -CONH(R<sup>4</sup>), -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, or -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and Q is -S- or -NH-; and
- (c)  $R^2$  is hydrogen or a substituted or unsubstituted C<sub>1-6</sub> aliphatic, and L is -O-, -S-, or -NH-.

Representative compounds of formula IIb are shown below in Table 2.

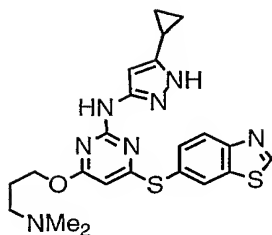
Table 2.



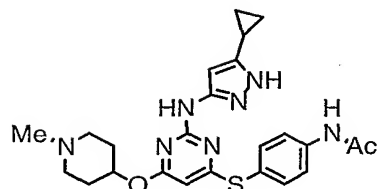
-51-



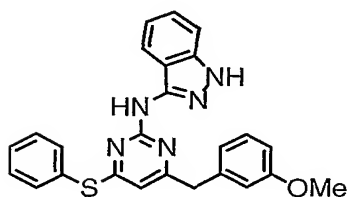
IIb-4



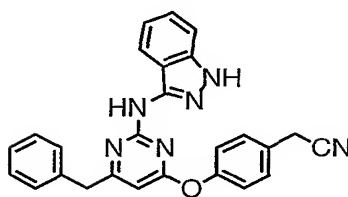
IIb-5



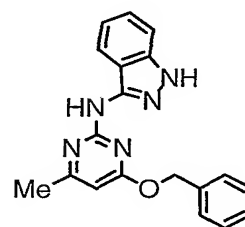
IIb-6



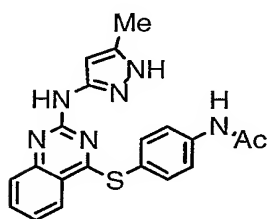
IIb-7



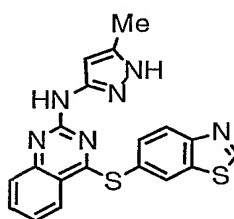
IIb-8



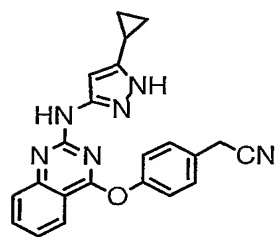
IIb-9



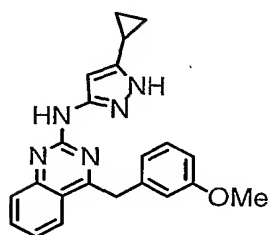
IIb-10



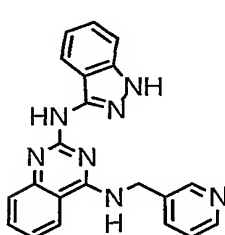
IIb-11



IIb-12



IIb-13



IIb-14



IIb-15

In another embodiment, this invention provides a composition comprising a compound of formula **IIb** and a pharmaceutically acceptable carrier.

Another aspect of this invention relates to a  
5 method of treating or preventing an Aurora-2-mediated



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disease with an Aurora-2 inhibitor, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a compound of formula **IIb** or a pharmaceutical composition thereof.

Another aspect of this invention relates to a method of inhibiting Aurora-2 activity in a patient, which method comprises administering to the patient a compound of formula **IIb** or a composition comprising said compound.

Another aspect of this invention relates to a method of treating or preventing a GSK-3-mediated disease with a GSK-3 inhibitor, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a compound of formula **IIb** or a pharmaceutical composition thereof.

One aspect of this invention relates to a method of enhancing glycogen synthesis and/or lowering blood levels of glucose in a patient in need thereof, which method comprises administering to the patient a therapeutically effective amount of a compound of formula **IIb** or a pharmaceutical composition thereof. This method is especially useful for diabetic patients. Another method relates to inhibiting the production of hyperphosphorylated Tau protein, which is useful in halting or slowing the progression of Alzheimer's disease. Another method relates to inhibiting the phosphorylation of  $\beta$ -catenin, which is useful for treating schizophrenia.

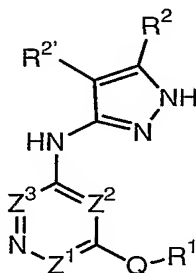
Another aspect of this invention relates to a method of inhibiting GSK-3 activity in a patient, which method comprises administering to the patient a compound of formula **IIb** or a composition comprising said compound.

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Another method relates to inhibiting Aurora-2 or GSK-3 activity in a biological sample, which method comprises contacting the biological sample with the Aurora-2 or GSK-3 inhibitor of formula **IIb**, or a pharmaceutical composition thereof, in an amount effective to inhibit Aurora-2 or GSK-3.

Each of the aforementioned methods directed to the inhibition of Aurora-2 or GSK-3, or the treatment of a disease alleviated thereby, is preferably carried out with a preferred compound of formula **IIb**, as described above.

Another embodiment of this invention relates to compounds of formula **III**:

**III**

or a pharmaceutically acceptable derivative or prodrug thereof, wherein:

$Z^1$  is nitrogen or  $CR^8$ ,  $Z^2$  is nitrogen or CH, and  $Z^3$  is nitrogen or  $CR^x$ , provided that one of  $Z^1$  and  $Z^3$  is nitrogen;

$R^x$  is T- $R^3$  or L-Z- $R^3$ ;

Q is selected from -N( $R^4$ )-, -O-, -S-, or -CH( $R^6$ )-;

$R^1$  is T-(Ring D);

Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl, said heteroaryl or

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heterocyclyl ring having 1-4 ring heteroatoms selected from nitrogen, oxygen or sulfur, wherein each substitutable ring carbon of Ring D is independently substituted by oxo, T-R<sup>5</sup>, or V-Z-R<sup>5</sup>, and each

5 substitutable ring nitrogen of Ring D is independently substituted by -R<sup>4</sup>;

T is a valence bond or a C<sub>1-4</sub> alkylidene chain, wherein when Q is -CH(R<sup>6</sup>)-, a methylene unit of said C<sub>1-4</sub> alkylidene chain is optionally replaced by -O-, -S-,

10 -N(R<sup>4</sup>)-, -CO-, -CONH-, -NHCO-, -SO<sub>2</sub>-, -SO<sub>2</sub>NH-, -NHSO<sub>2</sub>-, -CO<sub>2</sub>-, -OC(O)-, -OC(O)NH-, or -NHCO<sub>2</sub>-;

Z is a C<sub>1-4</sub> alkylidene chain;

L is -O-, -S-, -SO-, -SO<sub>2</sub>-, -N(R<sup>6</sup>)SO<sub>2</sub>-, -SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -N(R<sup>6</sup>)CO-, -N(R<sup>6</sup>)C(O)O-,

15 -N(R<sup>6</sup>)CON(R<sup>6</sup>)-, -N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(O)N(R<sup>6</sup>)-, -OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, or

20 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-;

R<sup>2</sup> and R<sup>2'</sup> are independently selected from -R, -T-W-R<sup>6</sup>, or R<sup>2</sup> and R<sup>2'</sup> are taken together with their intervening atoms to form a fused, 5-8 membered, unsaturated or partially unsaturated, ring having 0-3 ring heteroatoms

25 selected from nitrogen, oxygen, or sulfur, wherein each substitutable ring carbon of said fused ring formed by R<sup>2</sup> and R<sup>2'</sup> is independently substituted by halo, oxo, -CN, -NO<sub>2</sub>, -R<sup>7</sup>, or -V-R<sup>6</sup>, and each substitutable ring nitrogen of said ring formed by R<sup>2</sup> and R<sup>2'</sup> is

30 independently substituted by R<sup>4</sup>;

R<sup>3</sup> is selected from -R, -halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR, -COCH<sub>2</sub>COR, -NO<sub>2</sub>, -CN, -S(O)R, -S(O)<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>7</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>7</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>7</sup>)COR,

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-N(R<sup>7</sup>)CO<sub>2</sub>(C<sub>1-6</sub> aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>,  
 -C=N-OR, -N(R<sup>7</sup>)CON(R<sup>7</sup>)<sub>2</sub>, -N(R<sup>7</sup>)SO<sub>2</sub>N(R<sup>7</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or  
 -OC(=O)N(R<sup>7</sup>)<sub>2</sub>;

each R is independently selected from hydrogen or an  
 5 optionally substituted group selected from C<sub>1-6</sub>  
 aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10  
 ring atoms, or a heterocyclyl ring having 5-10 ring  
 atoms;

each R<sup>4</sup> is independently selected from -R<sup>7</sup>, -COR<sup>7</sup>,  
 10 -CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic), -CON(R<sup>7</sup>)<sub>2</sub>,  
 or -SO<sub>2</sub>R<sup>7</sup>;

each R<sup>5</sup> is independently selected from -R, halo, -OR,  
 -C(=O)R, -CO<sub>2</sub>R, -COCOR, -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR,  
 -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR,  
 15 -N(R<sup>4</sup>)CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic),  
 -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>,  
 -N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or -OC(=O)N(R<sup>4</sup>)<sub>2</sub>;

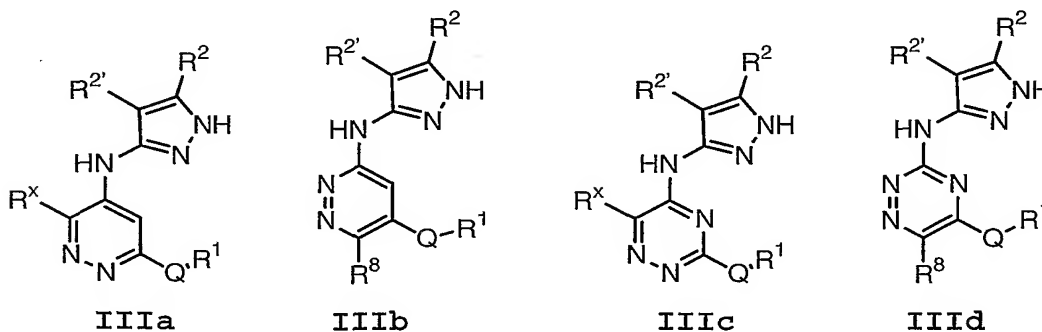
V is -O-, -S-, -SO-, -SO<sub>2</sub>-, -N(R<sup>6</sup>)SO<sub>2</sub>-, -SO<sub>2</sub>N(R<sup>6</sup>)-,  
 -N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -N(R<sup>6</sup>)CO-, -N(R<sup>6</sup>)C(O)O-,  
 20 -N(R<sup>6</sup>)CON(R<sup>6</sup>)-, -N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)N(R<sup>6</sup>)-,  
 -C(O)N(R<sup>6</sup>)-, -OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-,  
 -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-,  
 -C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, or  
 25 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-;

W is -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-,  
 -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-,  
 -C(R<sup>6</sup>)OC(O)-, -C(R<sup>6</sup>)OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CO-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-,  
 30 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-,  
 -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-, or -CON(R<sup>6</sup>)-;

each R<sup>6</sup> is independently selected from hydrogen or an  
 optionally substituted C<sub>1-4</sub> aliphatic group, or two R<sup>6</sup>

-56-

- groups on the same nitrogen atom are taken together with the nitrogen atom to form a 5-6 membered heterocyclyl or heteroaryl ring;
- each  $R^7$  is independently selected from hydrogen or an
- 5 optionally substituted  $C_{1-6}$  aliphatic group, or two  $R^7$  on the same nitrogen are taken together with the nitrogen to form a 5-8 membered heterocyclyl or heteroaryl ring; and
- $R^8$  is selected from -R, halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR,
- 10 -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)CO<sub>2</sub>(optionally substituted  $C_{1-6}$  aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or -OC(=O)N(R<sup>4</sup>)<sub>2</sub>.
- 15 Accordingly, the present invention relates to compounds of formula **IIIa**, **IIIb**, **IIIc** and **IIId** as shown below:



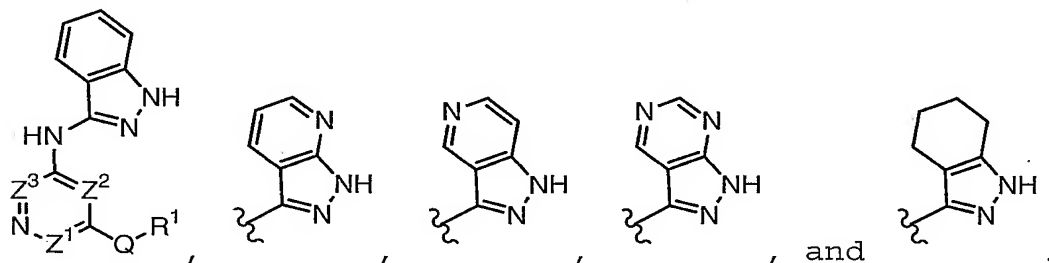
- Preferred  $R^x$  groups of formula **III** include T- $R^3$  wherein T is a valence bond or a methylene and  $R^3$  is CN,
- 20 -R, or -OR. When  $R^3$  is -R, preferred  $R^3$  groups include an optionally substituted group selected from  $C_{1-6}$  aliphatic, phenyl, or a 5-6 membered heteroaryl or heterocyclyl ring. When  $R^3$  is -OR, preferred R groups include an optionally substituted group  $C_{1-6}$  aliphatic group such as

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alkyl- or dialkylaminoalkyl and aminoalkyl. Examples of preferred  $R^x$  include acetamido, CN, piperidinyl, piperazinyl, phenyl, pyridinyl, imidazol-1-yl, imidazol-2-yl, cyclohexyl, cyclopropyl, methyl, ethyl, isopropyl, t-butyl,  $NH_2CH_2CH_2NH$ , and  $NH_2CH_2CH_2O$ .

Preferred  $R^8$  groups of formula **III**, when present, include R, OR, and  $N(R^4)_2$ . Examples of preferred  $R^8$  include methyl, ethyl,  $NH_2$ ,  $NH_2CH_2CH_2NH$ ,  $N(CH_3)_2CH_2CH_2NH$ ,  $N(CH_3)_2CH_2CH_2O$ , (piperidin-1-yl) $CH_2CH_2O$ , and  $NH_2CH_2CH_2O$ .

The  $R^2$  and  $R^{2'}$  groups of formula **III** may be taken together to form a fused ring, thus providing a bicyclic ring system containing a pyrazole ring. Preferred fused rings include benzo, pyrido, pyrimido, and a partially unsaturated 6-membered carbocyclo ring. These are exemplified in the following formula **III** compounds having a pyrazole-containing bicyclic ring system:



Preferred substituents on the formula **III**  $R^2/R^{2'}$  fused ring include one or more of the following: -halo, - $N(R^4)_2$ , - $C_{1-4}$  alkyl, - $C_{1-4}$  haloalkyl, - $NO_2$ , - $O(C_{1-4}$  alkyl), - $CO_2(C_{1-4}$  alkyl), -CN, - $SO_2(C_{1-4}$  alkyl), - $SO_2NH_2$ , - $OC(O)NH_2$ , - $NH_2SO_2(C_{1-4}$  alkyl), - $NHC(O)(C_{1-4}$  alkyl), - $C(O)NH_2$ , and - $CO(C_{1-4}$  alkyl), wherein the  $(C_{1-4}$  alkyl) is a straight, branched, or cyclic alkyl group. Preferably, the  $(C_{1-4}$  alkyl) group is methyl.

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When the pyrazole ring system of formula **III** is monocyclic, preferred  $R^2$  groups include hydrogen or a substituted or unsubstituted group selected from aryl, heteroaryl, or a  $C_{1-6}$  aliphatic group. Examples of such preferred  $R^2$  groups include H, methyl, ethyl, propyl, , cyclopropyl, i-propyl, cyclopentyl, hydroxypropyl, methoxypropyl, and benzyloxypropyl. A preferred  $R^{2'}$  group is hydrogen.

When Ring D of formula **III** is monocyclic, preferred Ring D groups include phenyl, pyridyl, pyridazinyl, pyrimidinyl, and pyrazinyl.

When Ring D of formula **III** is bicyclic, preferred bicyclic Ring D groups include naphthyl, tetrahydronaphthyl, indanyl, benzimidazolyl, quinolinyl, indolyl, isoindolyl, indolinyl, benzo[b]furyl, benzo[b]thiophenyl, indazolyl, benzothiazolyl, cinnolinyl, phthalazinyl, quinazolinyl, quinoxalinyl, 1,8-naphthyridinyl and isoquinolinyl.

On Ring D of formula **III**, preferred  $T-R^5$  or  $V-Z-R^5$  substituents include -halo, -CN, -NO<sub>2</sub>, -N( $R^4$ )<sub>2</sub>, optionally substituted  $C_{1-6}$  aliphatic group, -OR, -C(O)R, -CO<sub>2</sub>R, -CON( $R^4$ )<sub>2</sub>, -OCO( $R^4$ )<sub>2</sub>, -N( $R^4$ )COR, -N( $R^4$ )CO<sub>2</sub>R, -SO<sub>2</sub>N( $R^4$ )<sub>2</sub>, -N( $R^4$ )SO<sub>2</sub>R, -N( $R^6$ )COCH<sub>2</sub>N( $R^4$ )<sub>2</sub>, -N( $R^6$ )COCH<sub>2</sub>CH<sub>2</sub>N( $R^4$ )<sub>2</sub>, and -N( $R^6$ )COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N( $R^4$ )<sub>2</sub>, wherein R is selected from hydrogen,  $C_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring. More preferred  $R^5$  substituents include -Cl, -Br, -F, -CN, -CF<sub>3</sub>, -COOH, -CONHMe, -CONHEt, -NH<sub>2</sub>, -NHAc, -NHSO<sub>2</sub>Me, -NHSO<sub>2</sub>Et, -NHSO<sub>2</sub>(n-propyl), -NHSO<sub>2</sub>(isopropyl), -NHCOEt, -NHCOCH<sub>2</sub>NHCH<sub>3</sub>, -NHCOCH<sub>2</sub>N(CO<sub>2</sub>t-Bu)CH<sub>3</sub>, -NHCOCH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>, -NHCOCH<sub>2</sub>CH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>, -NHCOCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>, -NHCO(cyclopropyl), -NHCO(isobutyl), -NHCOCH<sub>2</sub>(morpholin-4-yl), -NHCOCH<sub>2</sub>CH<sub>2</sub>(morpholin-4-yl), -NHCOCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>(morpholin-

-59-

4-yl), -NHCO<sub>2</sub>(t-butyl), -NH(C<sub>1-4</sub> aliphatic) such as -NHMe, -N(C<sub>1-4</sub> aliphatic)<sub>2</sub> such as -NMe<sub>2</sub>, OH, -O(C<sub>1-4</sub> aliphatic) such as -OMe, C<sub>1-4</sub> aliphatic such as methyl, ethyl, cyclopropyl, isopropyl, or t-butyl, and -CO<sub>2</sub>(C<sub>1-4</sub> aliphatic).

Preferred compounds of formula **IIIa**, **IIIb**, **IIIc**, or **IIId** have one or more, and more preferably all, of the features selected from the group consisting of:

- (a) R<sup>x</sup> is hydrogen, alkyl- or dialkylamino, acetamido, or a C<sub>1-4</sub> aliphatic group;
- (b) R<sup>1</sup> is T-(Ring D), wherein T is a valence bond or a methylene unit;
- (c) Ring D is a 5-7 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d) R<sup>2</sup> is -R or -T-W-R<sup>6</sup> and R<sup>2'</sup> is hydrogen, or R<sup>2</sup> and R<sup>2'</sup> are taken together to form an optionally substituted benzo ring.

More preferred compounds of formula **IIIa**, **IIIb**, **IIIc**, or **IIId** have one or more, and more preferably all, of the features selected from the group consisting of:

- (a) R<sup>1</sup> is T-(Ring D), wherein T is a valence bond, and Q is -S-, -NH-, or -CH<sub>2</sub>-;
- (b) Ring D is a 5-6 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (c) R<sup>2</sup> is -R and R<sup>2'</sup> is hydrogen, wherein R is selected from hydrogen, C<sub>1-6</sub> aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring.

Even more preferred compounds of formula **IIIa**, **IIIb**, **IIIc**, or **IIId** have one or more, and more preferably all, of the features selected from the group consisting of:

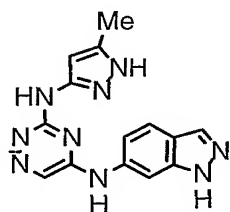


-60-

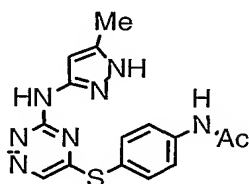
- (a)  $R^x$  is hydrogen methyl, ethyl, propyl, cyclopropyl, isopropyl, methylamino or acetimido;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Ring D is a 5-6 membered aryl or heteroaryl ring, wherein Ring D is optionally substituted with one to two groups selected from -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted C<sub>1-6</sub> aliphatic group, -OR, -CO<sub>2</sub>R, -CON(R<sup>4</sup>)<sub>2</sub>, -OCO(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, or -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and Q is -S- or -NH-; and
- (c)  $R^2$  is hydrogen or a substituted or unsubstituted C<sub>1-6</sub> aliphatic.

Representative compounds of formula III are shown below in Table 3.

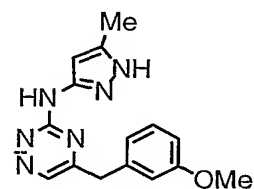
Table 3.



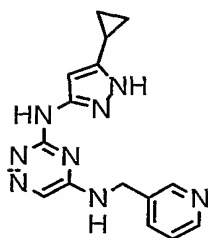
III-1



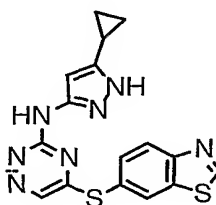
III-2



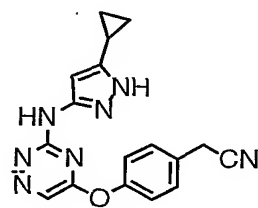
III-3



III-4

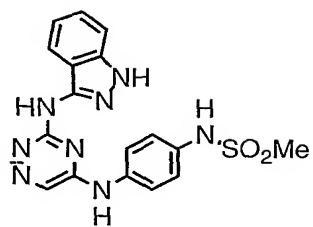


III-5

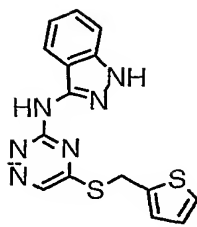


III-6

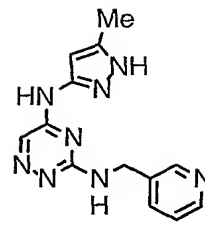
-61-



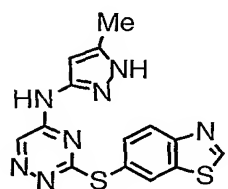
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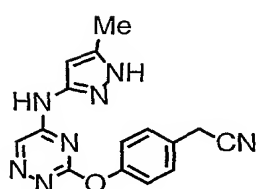
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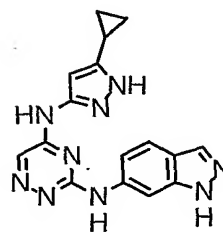
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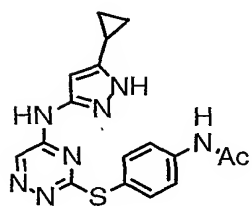
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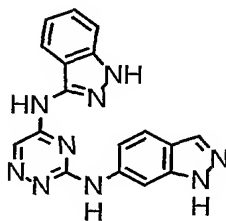
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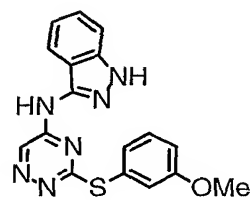
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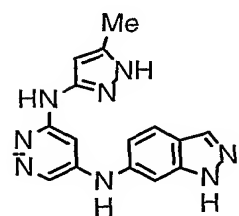
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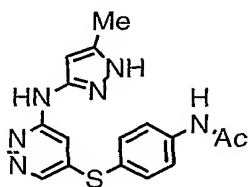
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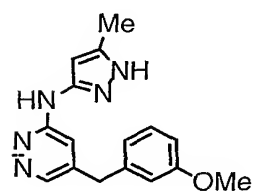
III-15



III-16

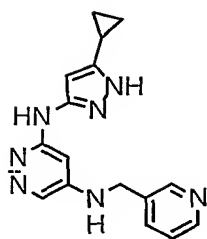


III-17

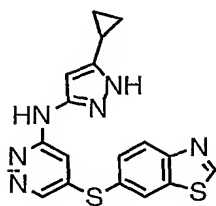


III-18

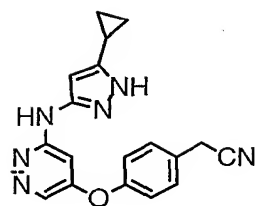
- 62 -



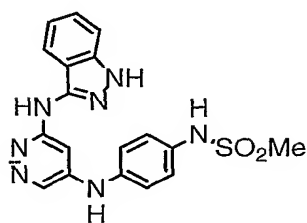
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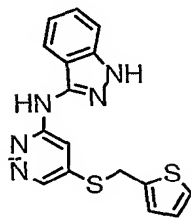
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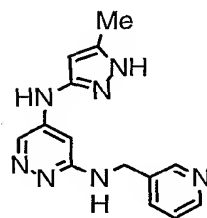
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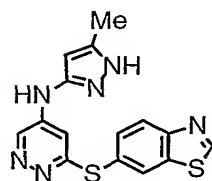
III-22



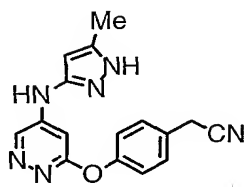
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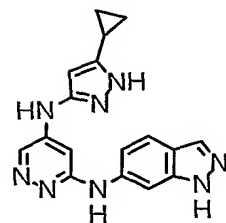
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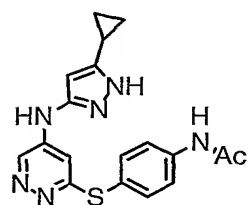
III-25



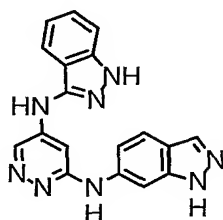
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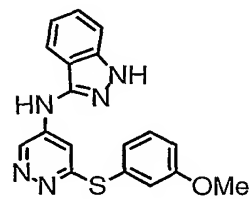
III-27



III-28



III-29



III-30

In another embodiment, this invention provides a composition comprising a compound of formula III and a pharmaceutically acceptable carrier.

Another aspect of this invention relates to a  
5 method of treating or preventing an Aurora-2-mediated

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disease with an Aurora-2 inhibitor, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a compound of formula **III** or a pharmaceutical composition thereof.

Another aspect of this invention relates to a method of inhibiting Aurora-2 activity in a patient, which method comprises administering to the patient a compound of formula **III** or a composition comprising said compound.

Another aspect of this invention relates to a method of treating or preventing a GSK-3-mediated disease with a GSK-3 inhibitor, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a compound of formula **III** or a pharmaceutical composition thereof.

One aspect of this invention relates to a method of enhancing glycogen synthesis and/or lowering blood levels of glucose in a patient in need thereof, which method comprises administering to the patient a therapeutically effective amount of a compound of formula **III** or a pharmaceutical composition thereof. This method is especially useful for diabetic patients. Another method relates to inhibiting the production of hyperphosphorylated Tau protein, which is useful in halting or slowing the progression of Alzheimer's disease. Another method relates to inhibiting the phosphorylation of  $\beta$ -catenin, which is useful for treating schizophrenia.

Another aspect of this invention relates to a method of inhibiting GSK-3 activity in a patient, which method comprises administering to the patient a compound of formula **III** or a composition comprising said compound.

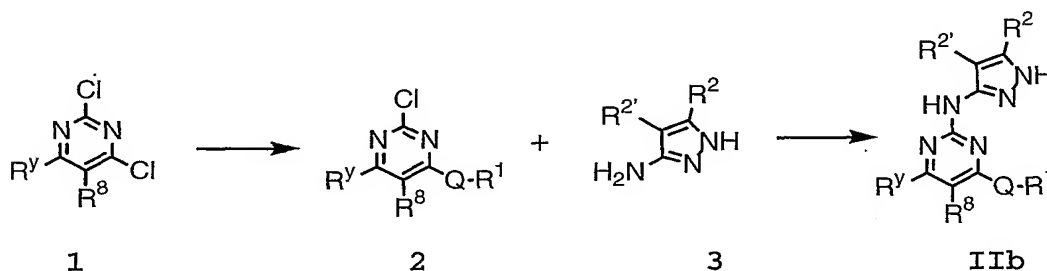
-64-

Another method relates to inhibiting Aurora-2 or GSK-3 activity in a biological sample, which method comprises contacting the biological sample with the Aurora-2 or GSK-3 inhibitor of formula **III**, or a pharmaceutical composition thereof, in an amount effective to inhibit Aurora-2 or GSK-3.

Each of the aforementioned methods directed to the inhibition of Aurora-2 or GSK-3, or the treatment of a disease alleviated thereby, is preferably carried out with a preferred compound of formula **III** as described above.

The compounds of this invention may be prepared in general by methods known to those skilled in the art for analogous compounds, as illustrated by the general Schemes I-VII.

#### Scheme I

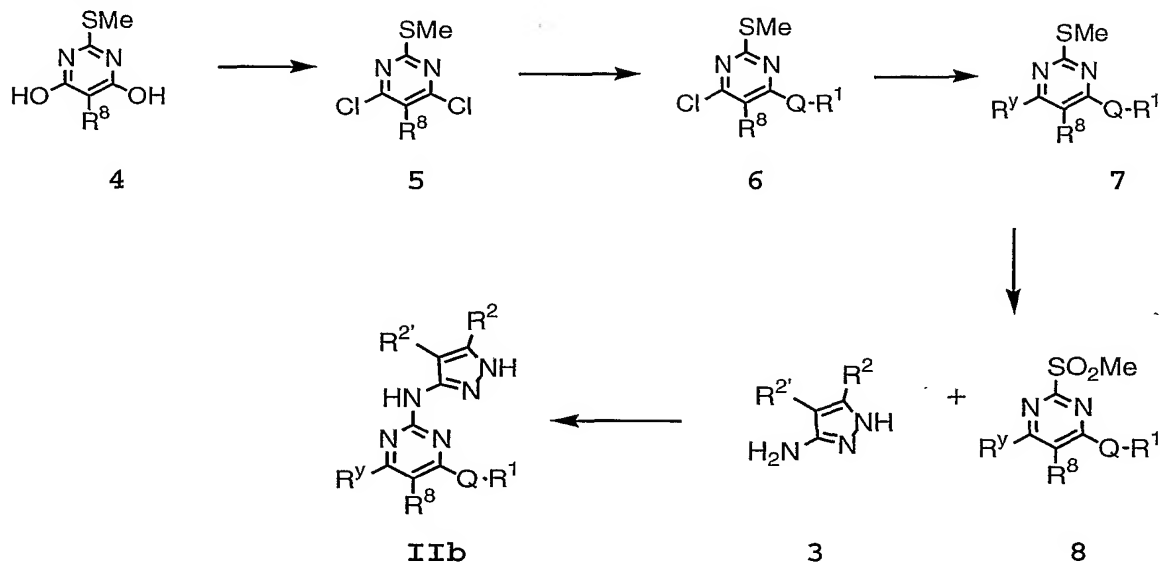


Scheme I above shows a general route for the preparation of compounds of formula **IIb**. The dichloro intermediate **1** (prepared using methods similar to those reported in *J. Indian. Chem. Soc.*, **61**, 690-693 (1984) or in *J. Med. Chem.*, **37**, 3828-3833 (1994)) is sequentially reacted with two nucleophiles:  $R^1$ -QH to displace the chloride at position 4 to afford intermediate **2**; and then **2** is treated with an aminopyrazole (or aminoindazole) to displace the chloride at position 2, using procedures

-65-

similar to those described in *J. Med. Chem.*, **38**, 14, 2763-2773, (1995) to afford compounds of formula **IIb**.

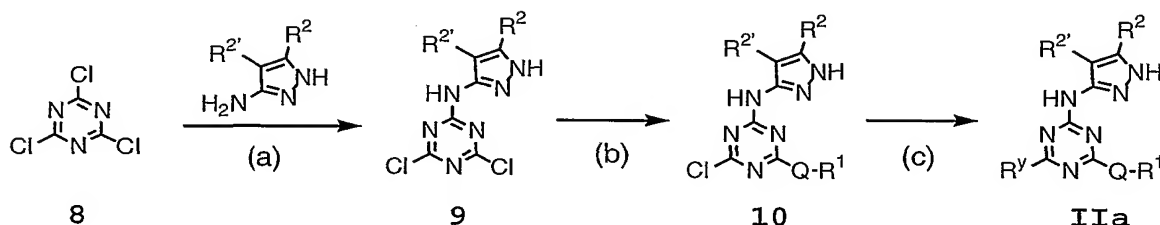
Scheme II



Scheme II above shows a general route for the preparation of compounds of formula **IIb** wherein Q is an N, O or S linker and  $R^Y$  is a group attached to the pyrimidine core via a heteroatom. Starting material 4,6-dihydroxy-2-methylsulfanylpurine (**4**) is prepared using procedures similar to those reported in *J. Med. Chem.*, **27**, 12, 1621-1629 (1984). Chlorination of **4** with  $POCl_3$  affords the dichloro intermediate **5**. The two chlorides of **5** are sequentially displaced with the appropriate  $R^1-QH$ , to afford compound **6**, and then with  $R^Y-H$  (amine, alcohol, or thiol) to afford compound **7** using procedures similar to those reported in US Patent 2,585,906. Alternatively, the order of displacement may be reversed by first displacing with  $R^Y-H$  and then with  $R^1-QH$ . The methyl sulfanyl group of compound **7** is then oxidized (for example, with oxone) to afford compound **8** and the resulting methylsulfonyl is finally displaced with the amino moiety of aminopyrazole (or aminoindazole)

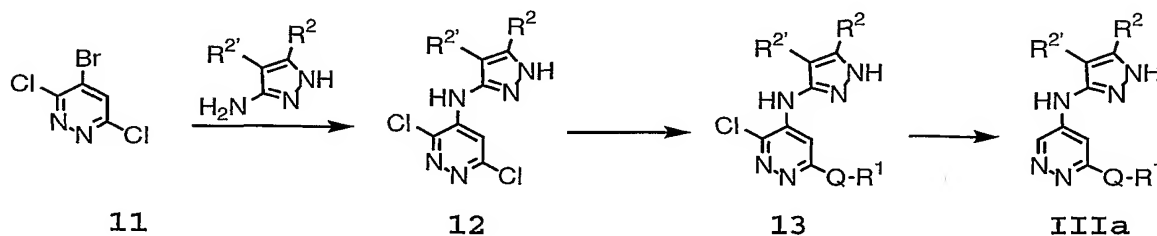
by methods substantially similar to those described above for Scheme 1 step (b) to afford compounds of formula **IIb**.

### Scheme III



Scheme III above shows a general route for the preparation of compounds of formula **IIa**. The three chlorides of starting material **8** are sequentially displaced with (a) the amino moiety of aminopyrazole (or aminoindazole) to afford compound **9**, (b) the  $R^1$ -QH group to afford compound **10**, and (c)  $R^y$ -H (amine, alcohol, or thiol) using procedures similar to the ones reported in *J. Indian Chem. Soc.*, **53**, 207-208, (1976) to afford compounds of formula **IIa**. These three steps can also be performed in different order to afford compounds of formula **IIa**.

### Scheme IV



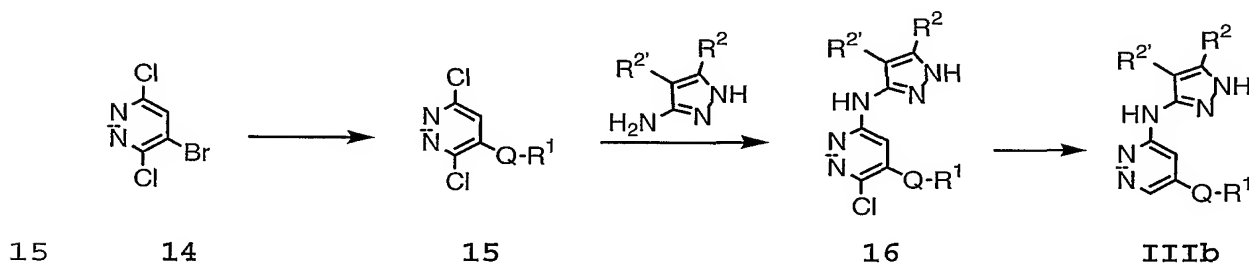
Scheme IV above shows a general route for the preparation of compounds of formula **IIIa**. Treatment of **11** with aminopyrazole (or aminoindazole) to provide **12** may be performed in a manner similar to that described in

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*Heterocycles*, 51, 5, 1999, 1035-1050. The intermediate 13 is obtained by displacement with  $R^1$ -QH in a manner similar to that described in *Farmaco. Ed. Sci.*, 27, 1972, 591-600. For the preparation of compounds of formula

5 **IIIa** where  $R^x$  is hydrogen, the chlorine may be removed by reduction. Alternatively, for the preparation of compounds of formula **IIIa** where  $R^x$  is other than hydrogen, the chlorine may be displaced by methods known to those skilled in the art to afford compounds with a variety of

10  $R^x$  substituents.

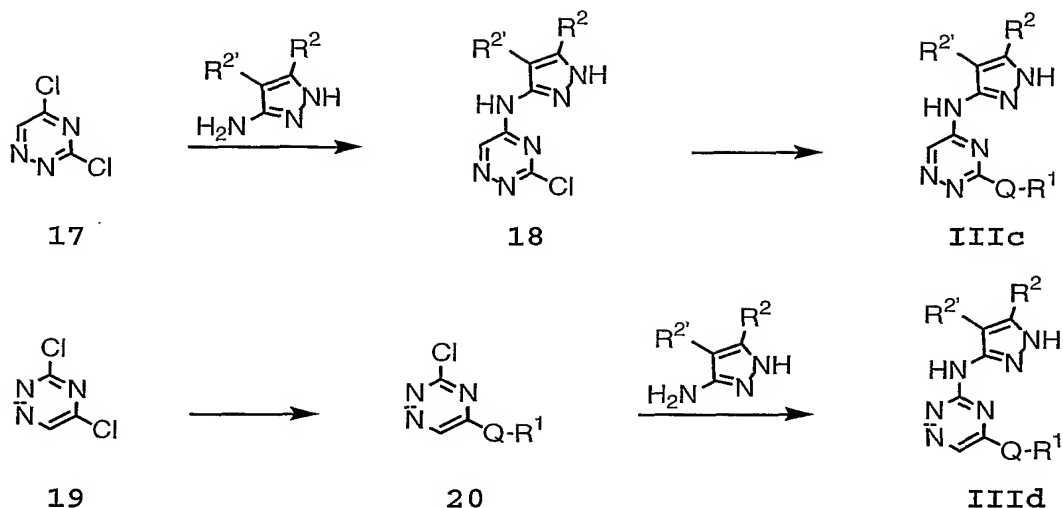
Scheme V

Scheme V above shows a general route for the preparation of the compounds of formula **IIIb**. Displacement of the bromide with  $R^1$ -QH to afford compound

20 **15** may be performed in a manner similar to that described in *Heterocycles*, 51, 5, 1999, 1035-1050. Displacement of the chlorines may be carried out sequentially as described above.



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Scheme VI

Scheme VI above shows a general route for the preparation of the compounds of formulae **IIIc** and **IIIId**. The displacement with aminopyrazole (or aminoindazole) followed by the displacement with  $\text{R}^1\text{-QH}$  may be performed in a manner similar to that described in *Indian J. Chem. Sect. B*, 29, 5, 1990, 435-439.

In order that the invention described herein may be more fully understood, the following examples are set forth. It should be understood that these examples are for illustrative purposes only and are not to be construed as limiting this invention in any manner.

BIOLOGICAL TESTING

The activity of the compounds as protein kinase inhibitors may be assayed *in vitro*, *in vivo* or in a cell line. *In vitro* assays include assays that determine inhibition of either the phosphorylation activity or ATPase activity of the activated protein kinase.

Alternate *in vitro* assays quantitate the ability of the inhibitor to bind to the protein kinase. Inhibitor

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binding may be measured by radiolabelling the inhibitor prior to binding, isolating the inhibitor/protein kinase complex and determining the amount of radiolabel bound. Alternatively, inhibitor binding may be determined by running a competition experiment where new inhibitors are incubated with the protein kinase bound to known radioligands.

#### BIOLOGICAL TESTING EXAMPLE 1

##### 10 K<sub>i</sub> DETERMINATION FOR THE INHIBITION OF GSK-3

Compounds are screened for their ability to inhibit GSK-3 $\beta$  (AA 1-420) activity using a standard coupled enzyme system (Fox et al. (1998) *Protein Sci.* 7, 2249). Reactions are carried out in a solution containing 100 mM HEPES (pH 7.5), 10 mM MgCl<sub>2</sub>, 25 mM NaCl, 300  $\mu$ M NADH, 1 mM DTT and 1.5% DMSO. Final substrate concentrations in the assay are 20  $\mu$ M ATP (Sigma Chemicals, St Louis, MO) and 300  $\mu$ M peptide (HSSPHQS(PO<sub>3</sub>H<sub>2</sub>)EDEEE, American Peptide, Sunnyvale, CA).

20 Reactions are carried out at 30 °C and 20 nM GSK-3 $\beta$ . Final concentrations of the components of the coupled enzyme system are 2.5 mM phosphoenolpyruvate, 300  $\mu$ M NADH, 30  $\mu$ g/ml pyruvate kinase and 10  $\mu$ g/ml lactate dehydrogenase.

25 An assay stock buffer solution is prepared containing all of the reagents listed above with the exception of ATP and the test compound of interest. The assay stock buffer solution (175  $\mu$ l) is incubated in a 96 well plate with 5  $\mu$ l of the test compound of interest at final concentrations spanning 0.002  $\mu$ M to 30  $\mu$ M at 30 °C for 10 min. Typically, a 12 point titration is conducted by preparing serial dilutions (from 10 mM compound

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stocks) with DMSO of the test compounds in daughter plates. The reaction is initiated by the addition of 20  $\mu$ l of ATP (final concentration 20  $\mu$ M). Rates of reaction are obtained using a Molecular Devices Spectramax plate reader (Sunnyvale, CA) over 10 min at 30°C. The  $K_i$  values are determined from the rate data as a function of inhibitor concentration.

#### BIOLOGICAL TESTING EXAMPLE 2

##### 10 $K_i$ DETERMINATION FOR THE INHIBITION OF AURORA-2

Compounds are screened in the following manner for their ability to inhibit Aurora-2 using a standard coupled enzyme assay (Fox et al (1998) *Protein Sci* 7, 2249).

15 To an assay stock buffer solution containing 0.1M HEPES 7.5, 10 mM  $MgCl_2$ , 1 mM DTT, 25 mM NaCl, 2.5 mM phosphoenolpyruvate, 300 mM NADH, 30 mg/ml pyruvate kinase, 10 mg/ml lactate dehydrogenase, 40 mM ATP, and 800  $\mu$ M peptide (LRRASLG, American Peptide, Sunnyvale, CA) is added a DMSO solution of a compound of the present invention to a final concentration of 30  $\mu$ M. The resulting mixture is incubated at 30 °C for 10 min. The reaction is initiated by the addition of 10  $\mu$ L of Aurora-2 stock solution to give a final concentration of 70 nM in the assay. The rates of reaction are obtained by monitoring absorbance at 340 nm over a 5 minute read time at 30 °C using a BioRad Ultramark plate reader (Hercules, CA). The  $K_i$  values are determined from the rate data as a function of inhibitor concentration.

30 While we have presented a number of embodiments of this invention, it is apparent that our basic construction can be altered to provide other embodiments which utilize the compounds and methods of this

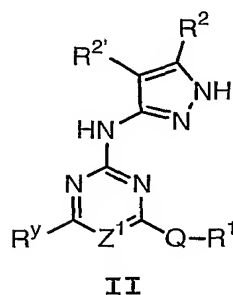
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invention. Therefore, it will be appreciated that the scope of this invention is to be defined by the appended claims rather than by the specific embodiments which have been represented by way of example.

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We claim:

1. A compound of formula II:



or a pharmaceutically acceptable derivative or prodrug thereof, wherein:

$Z^1$  is nitrogen or  $CR^8$ ;

$R^Y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms, or  $R^Y$  and  $R^8$  are taken together to form a fused, optionally substituted 5-7 membered, unsaturated or partially unsaturated, ring having 0-3 ring heteroatoms selected from nitrogen, oxygen, or sulfur;

$Q$  is selected from  $-N(R^4)-$ ,  $-O-$ ,  $-S-$ , or  $-CH(R^6)-$ ;

$R^1$  is T-(Ring D);

Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl, said heteroaryl or heterocyclyl ring having 1-4 ring heteroatoms selected from nitrogen, oxygen or sulfur, wherein each substitutable ring carbon of Ring D is independently substituted by oxo,  $T-R^5$ , or  $V-Z-R^5$ , and each substitutable ring nitrogen of Ring D is independently substituted by  $-R^4$ ;

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T is a valence bond or a C<sub>1-4</sub> alkylidene chain, wherein when Q is -CH(R<sup>6</sup>)-, a methylene unit of said C<sub>1-4</sub> alkylidene chain is optionally replaced by -O-, -S-, -N(R<sup>4</sup>)-, -CO-, -CONH-, -NHCO-, -SO<sub>2</sub>-, -SO<sub>2</sub>NH-, -NHSO<sub>2</sub>-, -CO<sub>2</sub>-, -OC(O)-, -OC(O)NH-, or -NHCO<sub>2</sub>-;

Z is a C<sub>1-4</sub> alkylidene chain;

L is -O-, -S-, -SO-, -SO<sub>2</sub>-, -N(R<sup>6</sup>)SO<sub>2</sub>-, -SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -N(R<sup>6</sup>)CO-, -N(R<sup>6</sup>)C(O)O-, -N(R<sup>6</sup>)CON(R<sup>6</sup>)-, -N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(O)N(R<sup>6</sup>)-, -OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, or -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-;

R<sup>2</sup> and R<sup>2'</sup> are independently selected from -R, -T-W-R<sup>6</sup>, or R<sup>2</sup> and R<sup>2'</sup> are taken together with their intervening atoms to form a fused, 5-8 membered, unsaturated or partially unsaturated, ring having 0-3 ring heteroatoms selected from nitrogen, oxygen, or sulfur, wherein each substitutable ring carbon of said fused ring formed by R<sup>2</sup> and R<sup>2'</sup> is independently substituted by halo, oxo, -CN, -NO<sub>2</sub>, -R<sup>7</sup>, or -V-R<sup>6</sup>, and each substitutable ring nitrogen of said ring formed by R<sup>2</sup> and R<sup>2'</sup> is independently substituted by R<sup>4</sup>;

R<sup>3'</sup> is selected from -halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR, -COCH<sub>2</sub>COR, -NO<sub>2</sub>, -CN, -S(O)R, -S(O)<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>7</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>7</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>7</sup>)COR, -N(R<sup>7</sup>)CO<sub>2</sub>(C<sub>1-6</sub> aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>7</sup>)CON(R<sup>7</sup>)<sub>2</sub>, -N(R<sup>7</sup>)SO<sub>2</sub>N(R<sup>7</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, -OC(=O)N(R<sup>7</sup>)<sub>2</sub>, or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;

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each R is independently selected from hydrogen or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;

each R<sup>4</sup> is independently selected from -R<sup>7</sup>, -COR<sup>7</sup>, -CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic), -CON(R<sup>7</sup>)<sub>2</sub>, or -SO<sub>2</sub>R<sup>7</sup>;

each R<sup>5</sup> is independently selected from -R, halo, -OR, -C(=O)R, -CO<sub>2</sub>R, -COCOR, -NO<sub>2</sub>, -CN, -S(O)R, -SO<sub>2</sub>R, -SR, -N(R<sup>4</sup>)<sub>2</sub>, -CON(R<sup>4</sup>)<sub>2</sub>, -SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -OC(=O)R, -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)CO<sub>2</sub>(optionally substituted C<sub>1-6</sub> aliphatic), -N(R<sup>4</sup>)N(R<sup>4</sup>)<sub>2</sub>, -C=NN(R<sup>4</sup>)<sub>2</sub>, -C=N-OR, -N(R<sup>4</sup>)CON(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, -N(R<sup>4</sup>)SO<sub>2</sub>R, or -OC(=O)N(R<sup>4</sup>)<sub>2</sub>;

V is -O-, -S-, -SO-, -SO<sub>2</sub>-, -N(R<sup>6</sup>)SO<sub>2</sub>-, -SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -N(R<sup>6</sup>)CO-, -N(R<sup>6</sup>)C(O)O-, -N(R<sup>6</sup>)CON(R<sup>6</sup>)-, -N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(O)N(R<sup>6</sup>)-, -OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, or -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-;

W is -C(R<sup>6</sup>)<sub>2</sub>O-, -C(R<sup>6</sup>)<sub>2</sub>S-, -C(R<sup>6</sup>)<sub>2</sub>SO-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>-, -C(R<sup>6</sup>)<sub>2</sub>SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)-, -CO-, -CO<sub>2</sub>-, -C(R<sup>6</sup>)OC(O)-, -C(R<sup>6</sup>)OC(O)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CO-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)C(O)O-, -C(R<sup>6</sup>)=NN(R<sup>6</sup>)-, -C(R<sup>6</sup>)=N-O-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)SO<sub>2</sub>N(R<sup>6</sup>)-, -C(R<sup>6</sup>)<sub>2</sub>N(R<sup>6</sup>)CON(R<sup>6</sup>)-, or -CON(R<sup>6</sup>)-;

each R<sup>6</sup> is independently selected from hydrogen or an optionally substituted C<sub>1-4</sub> aliphatic group, or two R<sup>6</sup> groups on the same nitrogen atom are taken together with the nitrogen atom to form a 5-6 membered heterocyclyl or heteroaryl ring;

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each  $R^7$  is independently selected from hydrogen or an optionally substituted  $C_{1-6}$  aliphatic group, or two  $R^7$  on the same nitrogen are taken together with the nitrogen to form a 5-8 membered heterocyclyl or heteroaryl ring; and

$R^8$  is selected from  $-R$ , halo,  $-OR$ ,  $-C(=O)R$ ,  $-CO_2R$ ,  $-COCOR$ ,  $-NO_2$ ,  $-CN$ ,  $-S(O)R$ ,  $-SO_2R$ ,  $-SR$ ,  $-N(R^4)_2$ ,  $-CON(R^4)_2$ ,  $-SO_2N(R^4)_2$ ,  $-OC(=O)R$ ,  $-N(R^4)COR$ ,  $-N(R^4)CO_2$  (optionally substituted  $C_{1-6}$  aliphatic),  $-N(R^4)N(R^4)_2$ ,  $-C=NN(R^4)_2$ ,  $-C=N-OR$ ,  $-N(R^4)CON(R^4)_2$ ,  $-N(R^4)SO_2N(R^4)_2$ ,  $-N(R^4)SO_2R$ , or  $-OC(=O)N(R^4)_2$ ; provided that when  $Q$  is  $-NH-$  and  $R^7$  and  $R^8$  are taken together,  $R^1$  is other than pyrazol-3-yl or a pyrazol-3-yl-containing bicyclic ring system.

2. The compound according to claim 1, wherein  $Z^1$  is nitrogen and said compound has one or more features selected from the group consisting of:

- (a)  $R^Y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein  $Z$  is a methylene and  $R^{3'}$  is  $-N(R^4)_2$ ,  $-OR$ , or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;
- (b)  $R^1$  is  $T-(\text{Ring D})$ , wherein  $T$  is a valence bond or a methylene unit;
- (c) Ring D is a 5-7 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is  $-R$  or  $-T-W-R^6$  and  $R^{2'}$  is hydrogen, or  $R^2$  and  $R^{2'}$  are taken together to form an optionally substituted benzo ring.



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3. The compound according to claim 2, wherein:

- (a)  $R^Y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein  $Z$  is a methylene and  $R^{3'}$  is  $-N(R^4)_2$ ,  $-OR$ , or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;
- (b)  $R^1$  is  $T-(\text{Ring D})$ , wherein  $T$  is a valence bond or a methylene unit;
- (c) Ring D is a 5-7 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is  $-R$  or  $-T-W-R^6$  and  $R^{2'}$  is hydrogen, or  $R^2$  and  $R^{2'}$  are taken together to form an optionally substituted benzo ring.

4. The compound according to claim 2, wherein said compound has one or more features selected from the group consisting of:

- (a)  $R^Y$  is an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl;
- (b)  $R^1$  is  $T-(\text{Ring D})$ , wherein  $T$  is a valence bond, and  $Q$  is  $-S-$ ,  $-NH-$ , or  $-CH_2-$ ;
- (c) Ring D is a 5-6 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is  $-R$  and  $R^{2'}$  is hydrogen, wherein  $R$  is selected from hydrogen,  $C_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring.

5. The compound according to claim 4, wherein:

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- (a)  $R^Y$  is an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond, and Q is -S-, -NH-, or -CH<sub>2</sub>-;
- (c) Ring D is a 5-6 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is -R and  $R^{2'}$  is hydrogen, wherein R is selected from hydrogen,  $C_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring.

6. The compound according to claim 4, wherein said compound has one or more features selected from the group consisting of:

- (a)  $R^Y$  is selected from 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino, alkoxyalkyl, alkyl- or dialkylamino, alkyl- or dialkylaminoalkoxy, acetamido, optionally substituted phenyl, or methoxymethyl;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Ring D is a 5-6 membered aryl or heteroaryl ring, wherein Ring D is optionally substituted with one to two groups selected from -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted  $C_{1-6}$  aliphatic group, -OR, -CO<sub>2</sub>R, -CONH(R<sup>4</sup>), -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, or -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and Q is -S- or -NH-; and
- (c)  $R^2$  is hydrogen or a substituted or unsubstituted  $C_{1-6}$  aliphatic, and L is -O-, -S-, or -NH-.

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7. The compound according to claim 6, wherein:
- (a)  $R^Y$  is selected from 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino, alkoxyalkyl, alkyl- or dialkylamino, alkyl- or dialkylaminoalkoxy, acetamido, optionally substituted phenyl, or methoxymethyl;
  - (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Ring D is a 5-6 membered aryl or heteroaryl ring, wherein Ring D is optionally substituted with one to two groups selected from -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted C<sub>1-6</sub> aliphatic group, -OR, -CO<sub>2</sub>R, -CONH(R<sup>4</sup>), -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, or -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and Q is -S- or -NH-; and
  - (c)  $R^2$  is hydrogen or a substituted or unsubstituted C<sub>1-6</sub> aliphatic, and L is -O-, -S-, or -NH-.

8. The compound according to claim 1, wherein  $Z^1$  is CR<sup>8</sup> and said compound has one or more features selected from the group consisting of:

- (a)  $R^Y$  is Z-R<sup>3'</sup> or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein Z is a methylene and R<sup>3'</sup> is -N(R<sup>4</sup>)<sub>2</sub>, -OR, or an optionally substituted group selected from C<sub>1-6</sub> aliphatic, C<sub>6-10</sub> aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond or a methylene unit;

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- (c) Ring D is a 5-7 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is  $-R$  or  $-T-W-R^6$  and  $R^{2'}$  is hydrogen, or  $R^2$  and  $R^{2'}$  are taken together to form an optionally substituted benzo ring.

9. The compound according to claim 8, wherein:

- (a)  $R^Y$  is  $Z-R^{3'}$  or an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl, wherein  $Z$  is a methylene and  $R^{3'}$  is  $-N(R^4)_2$ ,  $-OR$ , or an optionally substituted group selected from  $C_{1-6}$  aliphatic,  $C_{6-10}$  aryl, a heteroaryl ring having 5-10 ring atoms, or a heterocyclyl ring having 5-10 ring atoms;
- (b)  $R^1$  is  $T-(\text{Ring D})$ , wherein  $T$  is a valence bond or a methylene unit;
- (c) Ring D is a 5-7 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is  $-R$  or  $-T-W-R^6$  and  $R^{2'}$  is hydrogen, or  $R^2$  and  $R^{2'}$  are taken together to form an optionally substituted benzo ring.

10. The compound according to claim 8, wherein said compound has one or more features selected from the group consisting of:

- (a)  $R^Y$  is an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl;
- (b)  $R^1$  is  $T-(\text{Ring D})$ , wherein  $T$  is a valence bond, and  $Q$  is  $-S-$ ,  $-NH-$ , or  $-CH_2-$ ;
- (c) Ring D is a 5-6 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and

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(d)  $R^2$  is -R and  $R^{2'}$  is hydrogen, wherein R is selected from hydrogen,  $C_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring.

11. The compound according to claim 10, wherein:

- (a)  $R^Y$  is an optionally substituted group selected from  $C_{1-6}$  aliphatic, 5-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond, and Q is -S-, -NH-, or -CH<sub>2</sub>-;
- (c) Ring D is a 5-6 membered monocyclic or an 8-10 membered bicyclic aryl or heteroaryl ring; and
- (d)  $R^2$  is -R and  $R^{2'}$  is hydrogen, wherein R is selected from hydrogen,  $C_{1-6}$  aliphatic, phenyl, a 5-6 membered heteroaryl ring, or a 5-6 membered heterocyclic ring.

12. The compound according to claim 10, wherein said compound has one or more features selected from the group consisting of:

- (a)  $R^Y$  is selected from 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino, alkoxyalkyl, alkyl- or dialkylamino, alkyl- or dialkylaminoalkoxy, acetamido, optionally substituted phenyl, or methoxymethyl, or  $R^Y$  and  $R^8$  are taken together to form a 5-6 membered unsaturated or partially unsaturated ring having 0-2 heteroatoms selected from nitrogen, oxygen, or sulfur;

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- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Ring D is a 5-6 membered aryl or heteroaryl ring, wherein Ring D is optionally substituted with one to two groups selected from -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted C<sub>1-6</sub> aliphatic group, -OR, -CO<sub>2</sub>R, -CONH(R<sup>4</sup>), -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, or -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and Q is -S- or -NH-; and
- (c)  $R^2$  is hydrogen or a substituted or unsubstituted C<sub>1-6</sub> aliphatic, and L is -O-, -S-, or -NH-.

13. The compound according to claim 12, wherein:

- (a)  $R^Y$  is selected from 2-pyridyl, 4-pyridyl, pyrrolidinyl, piperidinyl, morpholinyl, piperazinyl, methyl, ethyl, cyclopropyl, isopropyl, t-butyl, alkoxyalkylamino, alkoxyalkyl, alkyl- or dialkylamino, alkyl- or dialkylaminoalkoxy, acetamido, optionally substituted phenyl, or methoxymethyl, or  $R^Y$  and  $R^8$  are taken together to form a 5-6 membered unsaturated or partially unsaturated ring having 0-2 heteroatoms selected from nitrogen, oxygen, or sulfur;
- (b)  $R^1$  is T-(Ring D), wherein T is a valence bond and Ring D is a 5-6 membered aryl or heteroaryl ring, wherein Ring D is optionally substituted with one to two groups selected from -halo, -CN, -NO<sub>2</sub>, -N(R<sup>4</sup>)<sub>2</sub>, optionally substituted C<sub>1-6</sub> aliphatic group, -OR, -CO<sub>2</sub>R, -CONH(R<sup>4</sup>), -N(R<sup>4</sup>)COR, -N(R<sup>4</sup>)SO<sub>2</sub>R, -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, or -N(R<sup>6</sup>)COCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>N(R<sup>4</sup>)<sub>2</sub>, and Q is -S- or -NH-; and
- (c)  $R^2$  is hydrogen or a substituted or unsubstituted C<sub>1-6</sub> aliphatic, and L is -O-, -S-, or -NH-.

14. A compound selected from the group consisting of:

6-Benzyl-*N*-(1*H*-indazol-6-yl)-*N'*-(5-methyl-1*H*-pyrazol-3-yl)-[1,3,5]-triazine-2,4-diamine;

6-Methyl-*N*-(5-methyl-1*H*-pyrazol-3-yl)-*N'*-pyridine-3-ylmethyl-[1,3,5]-triazine-2,4-diamine;

*N*-(4-{4-(5-Methyl-1*H*-pyrazol-3-ylamino)-6-[(pyridine-3-ylmethyl)-amino]-[1,3,5]-triazine-2-ylamino}-phenyl)-methanesulfonamide;

*N*-(4-[4-(2-Methoxy-ethylamino)-6-(5-methyl-1*H*-pyrazol-3-ylamino)-[1,3,5]-triazine-2-ylsulfanyl]-phenyl)-acetamide;

[4-(3-Dimethylamino-propoxy)-6-(thiophen-2-ylmethylsulfanyl)-[1,3,5]-triazine-2-yl]-(5-methyl-1*H*-pyrazol-3-yl)-amine;

[4-(Benzothiazol-6-ylsulfanyl)-6-phenylsulfanyl-[1,3,5]-triazine-2-yl]-(5-methyl-1*H*-pyrazol-3-yl)-amine;

*N*-(5-Cyclopropyl-1*H*-pyrazol-3-yl)-*N'*-(1*H*-indazol-6-yl)-6-(1-methyl-piperidin-4-yloxy)-[1,3,5]-triazine-2,4-diamine;

(4-{4-(5-Cyclopropyl-1*H*-pyrazol-3-ylamino)-6-[(pyridine-3-ylmethyl)-amino]-[1,3,5]-triazine-2-yloxy}-phenyl)-acetonitrile;

(4-Benzyl-6-methyl-[1,3,5]-triazine-2-yl)-(5-cyclopropyl-1*H*-pyrazol-3-yl)-amine;

*N*-(5-Cyclopropyl-1*H*-pyrazol-3-yl)-*N'*-(2-methoxyethyl)-6-(thiophen-2-ylmethylsulfanyl)-[1,3,5]-triazine-2,4-diamine;

[4-(Benzothiazol-6-ylsulfanyl)-6-(3-dimethylamino-propoxy)-[1,3,5]-triazine-2-yl]-(5-cyclopropyl-1*H*-pyrazol-3-yl)-amine;

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*N*-{4-[4-(5-Cyclopropyl-1*H*-pyrazol-3-ylamino)-6-(1-methyl-piperidin-4-yloxy)-[1,3,5]-triazine-2-yl-sulfanyl]-phenyl}-acetamide;

{4-[4-Benzyl-6-(1*H*-indazol-3-ylamino)-[1,3,5]-triazine-2-yloxy]-phenyl}-acetonitrile;

(4-Benzyl-6-methyl-[1,3,5]-triazine-2-yl)-(1*H*-indazol-3-yl)-amine;

6-Benzyl-*N*<sup>4</sup>-(1*H*-indazol-6-yl)-*N*<sup>2</sup>-(5-methyl-1*H*-pyrazol-3-yl)-pyrimidine-2,4-diamine;

6-Methyl-*N*<sup>2</sup>-(5-methyl-1*H*-pyrazol-3-yl)-*N*<sup>4</sup>-pyridine-3-ylmethyl-pyrimidine-2,4-diamine;

*N*-(4-{2-(5-Methyl-1*H*-pyrazol-3-ylamino)-6-[(pyridin-3-ylmethyl)-amino]-pyrimidin-4-ylamino}-phenyl)-methanesulfonamide;

*N*<sup>2</sup>-(5-Cyclopropyl-1*H*-pyrazol-3-yl)-*N*<sup>4</sup>-(2-methoxyethyl)-6-(thiophen-2-ylmethylsulfanyl)-pyrimidine-2,4-diamine;

[4-(Benzothiazol-6-ylsulfanyl)-6-(3-dimethylamino-propoxy)-pyrimidin-2-yl]-(5-cyclopropyl-1*H*-pyrazol-3-yl)-amine;

*N*-(4-[2-(5-Cyclopropyl-1*H*-pyrazol-3-ylamino)-6-(1-methyl-piperidin-4-yloxy)-pyrimidin-4-ylsulfanyl]-phenyl)-acetamide;

*N*-{4-[2-(5-Methyl-1*H*-pyrazol-3-ylamino)-quinazolin-4-ylsulfanyl]-phenyl}-acetamide;

[4-(Benzothiazol-6-ylsulfanyl)-quinazolin-2-yl-(5-methyl-1*H*-pyrazol-3-yl)-amine;

{4-[2-(5-Cyclopropyl-1*H*-pyrazol-3-ylamino)-quinazolin-4-yloxy]-phenyl}-acetonitrile;

(5-Cyclopropyl-1*H*-pyrazol-3-yl)-[4-(3-methoxy-benzyl)-quinazolin-2-yl]-amine;

*N*<sup>2</sup>-(1*H*-Indazol-6-yl)-*N*<sup>4</sup>-pyridin-3-ylmethyl-quinazoline-2,4-diamine; and



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(4-(Benzyloxy-quinazolin-2-yl)-(1H-indazol-3-yl)-amine.

15. A composition comprising a compound according to any one of claims 1-14, and a pharmaceutically acceptable carrier.

16. The composition according to claim 15, further comprising an additional therapeutic agent.

17. A method of inhibiting Aurora-2 or GSK-3 activity in a biological sample comprising the step of contacting said biological sample with a compound according to any one of claims 1-14.

18. A method of inhibiting Aurora-2 activity in a patient comprising the step of administering to said patient a composition according to claim 15.

19. A method of inhibiting Aurora-2 activity in a patient comprising the step of administering to said patient a composition according to claim 16.

20. A method of treating an Aurora-2-mediated disease, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a composition according to claim 15.

21. The method according to claim 20, wherein said disease is selected from colon, breast, stomach, or ovarian cancer.

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22. The method according to claim 21, wherein said method further comprises administering an additional therapeutic agent.

23. The method according to claim 22, wherein said additional therapeutic agent is a chemotherapeutic agent.

24. A method of inhibiting GSK-3 activity in a patient comprising the step of administering to said patient a composition according to claim 15.

25. A method of inhibiting GSK-3 activity in a patient comprising the step of administering to said patient a composition according to claim 16.

26. A method of method of treating a GSK-3-mediated disease, which method comprises administering to a patient in need of such a treatment a therapeutically effective amount of a composition according to claim 15.

27. The method according to claim 26, wherein said GSK-3-mediated disease is selected from diabetes, Alzheimer's disease, Huntington's Disease, Parkinson's Disease, AIDS-associated dementia, amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), schizophrenia, cardiomyocyte hypertrophy, reperfusion/ischemia, or baldness.

28. The method according to claim 27, wherein said GSK-3-mediated disease is diabetes.

29. A method of enhancing glycogen synthesis or lowering blood levels of glucose in a patient in need

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thereof, which method comprises administering to said patient a therapeutically effective amount of a composition according to claim 15.

30. A method of inhibiting the production of hyperphosphorylated Tau protein in a patient, which method comprises administering to a patient in need thereof a therapeutically effective amount of a composition according to claim 15.

31. A method of inhibiting the phosphorylation of  $\beta$ -catenin, which method comprises administering to a patient in need thereof a therapeutically effective amount of a composition according to claim 15.

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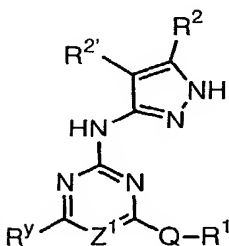
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(54) Title: PYRAZOLE COMPOUNDS USEFUL AS PROTEIN KINASE INHIBITORS



(II)

(57) Abstract: This invention describes novel pyrazole compounds of formula (II): wherein Z<sup>1</sup> is nitrogen or CR<sup>8</sup>; Q is -S-, -O-, -N(R<sup>6</sup>)-, or -CH(R<sup>6</sup>)-; R<sup>1</sup> is T-Ring D, wherein Ring D is a 5-7 membered monocyclic ring or 8-10 membered bicyclic ring selected from aryl, heteroaryl, heterocyclyl or carbocyclyl; and R<sup>3</sup>, R<sup>2</sup>, and R<sup>2</sup> are as described in the specification. The compounds are useful as protein kinase inhibitors, especially as inhibitors of Aurora-2 and GSK-3, for treating diseases such as cancer, diabetes and Alzheimer's disease.

## INTERNATIONAL SEARCH REPORT

Inter. Application No  
PCT/US 01/49585

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 C07D403/14 A61K31/53 C07D401/14 C07D403/12 C07D409/14  
C07D417/14 A61K31/501 A61K31/506 A61P35/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, CHEM ABS Data, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 39101 A (BREault GLORIA ANNE ; PEASE JANET ELIZABETH (GB); ASTRAZENECA UK LT) 6 July 2000 (2000-07-06) examples 135,160,161 ---	1,15,21
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A	US 5 710 158 A (MYERS MICHAEL R ET AL) 20 January 1998 (1998-01-20) column 27 --- -/--	1,15,21

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
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- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

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## INTERNATIONAL SEARCH REPORT

Inter Application No

PCT/JP 01/49585

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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# INTERNATIONAL SEARCH REPORT

I International application No.  
PCT/US 01/49585

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
Although claims 17-31 are directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compounds.
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/49585

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